ACHIEVING A NET ZERO CARBON FUTURE

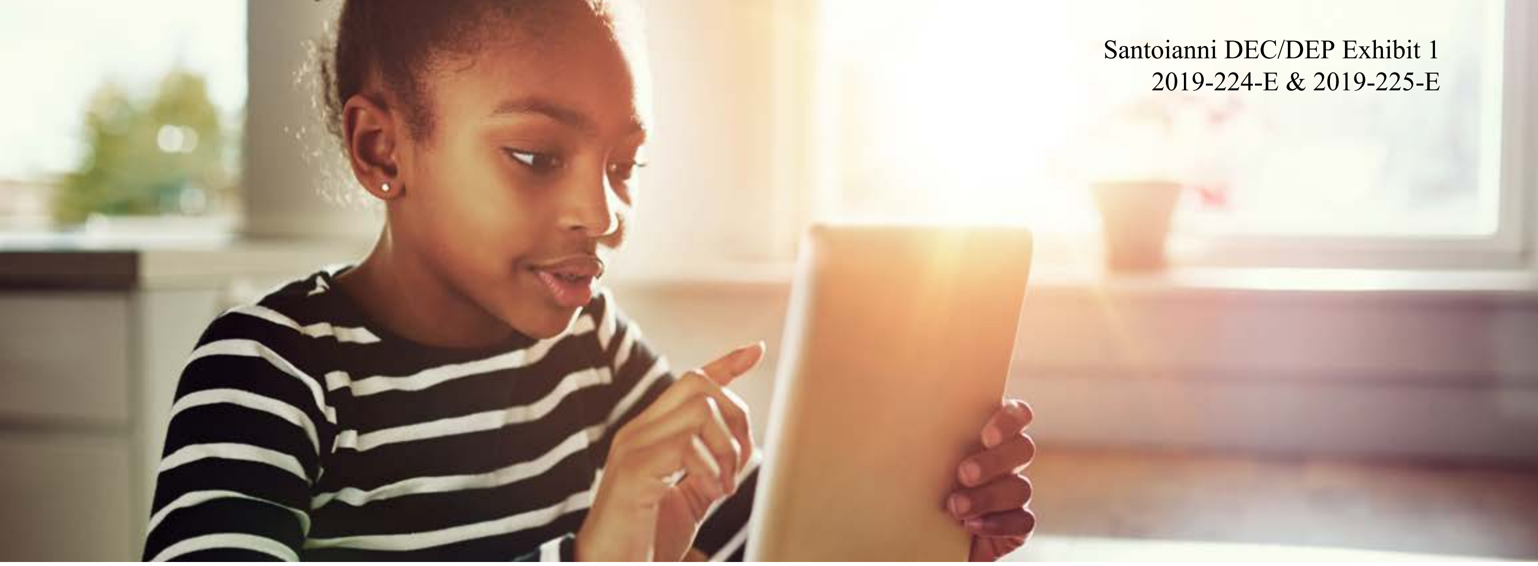
Duke Energy 2020 Climate Report

DUKE ENERGY

BUILDING A **SMARTER** ENERGY FUTURE ®

Contents

Duke Energy published this Climate Report during the COVID-19 (coronavirus) pandemic. Learn about the company's response to this crisis at dukeenergyupdates.com.



Executive Summary

As one of the largest electric and gas utilities in the U.S., Duke Energy embraces its responsibility not only to power the communities where our customers live and work, but also to address risks from climate change. Addressing the challenges climate change presents is a mission on which we all agree. We must double down on the hard work that will inform the technology, pace and cost of the transition, while always keeping affordability and reliability for our customers as our guiding beacons. Duke Energy will continue to help lead the effort to develop solutions to this complex challenge.

This report discusses how we are leaning in to this challenge and addressing climate risks by, first and foremost, reducing our own emissions and, secondly, by adapting our system to be more flexible and resilient.[1]

Our plans are guided by new carbon reduction goals that were announced in September of 2019. Duke Energy aims to reduce carbon dioxide (CO_2) emissions from electricity generation at least 50 percent below 2005 levels by 2030 and to achieve net-zero CO_2 emissions by 2050.[2]

We have already made significant progress toward our updated goals, reducing CO_2 emissions 39 percent since 2005, ahead of the industry average of 33 percent.[3] To build our path to net zero, we will work collaboratively with stakeholders and regulators in each of the states we serve to develop specific plans that best suit their unique attributes and economies. This will be an exciting transformation that evolves and adapts over time. This report offers insights into the complexities and opportunities ahead and provides an enterprise-level scenario analysis with an illustrative path to net zero, based on what we know today.[4]

This scenario analysis was conducted using our industry-standard resource planning tools and assuming normal weather (averages over the past 30 years). The major findings of this scenario analysis are:

- We are on track to achieve our 2030 goal of reducing CO_2 emissions from electricity generation by at least 50 percent from 2005 levels.
- The path to net zero by 2050 will require additional coal retirements, significant growth in renewables and energy storage, continued utilization of natural gas, ongoing operation of our nuclear fleet, and advancements in load-management programs and rate design (demand side management and energy efficiency). Importantly, this path also depends on the availability of advanced very low- and zero-carbon

[1] This report, like our 2017 Climate Report to Shareholders, is aligned with the disclosures recommended by the Task Force on Climate-related Financial Disclosures (TCFD).
[2] These goals are enterprisewide. Each jurisdiction will have a different trajectory toward achieving them.
[3] U.S. Energy Information Administration, *Monthly Energy Review*, March 26, 2020.
[4] This scenario analysis does not model specific climate policies but has helped us identify key attributes of policies that will help us achieve our goals. These are discussed in the policy risks section on page 15.

technologies that can be dispatched to meet energy demand. These "zero-emitting load-following resources" (ZELFRs) will need to be installed as early as 2035. This analysis projects that ZELFRs will make up 12 percent of the capacity mix and supply 30 percent of energy by 2050 due to their ability to operate at full output over extended periods regardless of weather conditions. See sidebar on ZELFRs.

- Our analysis also shows that while we project adding large amounts of renewable energy, natural gas units remain a necessary and economic resource to enable coal retirements and to maintain system reliability as we transition.[5] Natural gas – reinforced by adequate transport capacity – allows us to retire our remaining 16 gigawatts (GW) of coal and transition to net-zero CO_2 emissions by 2050 while maintaining affordability and reliability. Notably, as increasingly larger amounts of renewable energy and other zero-emitting resources are added, Duke Energy's natural gas fleet will shift from providing bulk energy supply to more of a peaking and demand-balancing role.

- We project continuing to need natural gas because, in jurisdictions such as ours where hourly demand for electricity is not well-correlated with hourly renewable generation, renewables are not operationally equivalent to natural gas generation, particularly for prolonged periods of cloudy weather and/or low wind speed conditions.

- We conducted a "no new gas" sensitivity to stress-test this projection. We find that while energy storage can help address the capacity and energy gap created by retirement of coal units, installation and operational challenges arise as we attempt to rely on current commercially available storage technologies to provide intermediate and baseload capabilities.

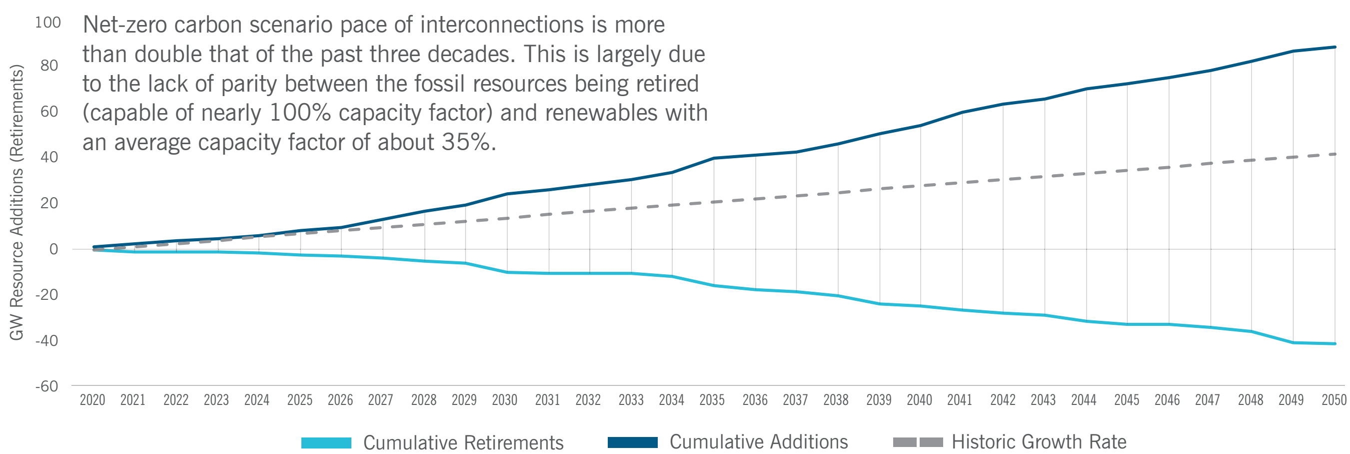
- For example, to enable coal retirements and accommodate load growth without adding natural gas, Duke Energy would need to install over 15,000 MW of additional four-, six- and eight-hour energy storage by 2030. That equates to a little over 17 times all the battery storage capacity installed nationwide today (899 MW).[6] The largest battery storage facility that exists in the world today is the Tesla-built 100-MW Hornsdale Power Reserve in Australia.[7] A larger 400-MW battery storage facility is currently under development in the Southeast.[8] These are important and encouraging developments, but it is notable that Duke Energy would need to build nearly 40 storage facilities like the one under development in the next nine years to reach

[5] Note that our analysis does include economic hurdles for natural gas to address the risk of stranded assets (see page 23 for discussion).
[6] EIA, U.S. Utility-scale battery storage power capacity to grow substantially by 2023, July 2019. https://www.eia.gov/todayinenergy/detail.php?id=40072 (showing 899 MW of battery storage as of 2019 and projecting 2,500 MW installed by 2023).
[7] https://hornsdalepowerreserve.com.au/
[8] http://newsroom.fpl.com/2019-03-28-FPL-announces-plan-to-build-the-worlds-largest-solar-powered-battery-and-drive-accelerated-retirement-of-fossil-fuel-generation

15,000 MW of storage. Due to this tight time frame, challenges would likely include regulatory approvals and permitting, interconnection studies and associated upgrades, and potential supply chain issues, considering the current early stage of the utility-scale battery storage industry.

- Taking this scale of battery implementation to real-world, reliable and affordable operations would require further detailed analysis and on-the-ground experience – among other factors – to determine operational feasibility. We are not aware of any electric utility in the U.S. that has attempted to serve customers reliably at scale with such a high proportion of capacity from energy storage. We discuss the detailed analysis needed before such implementation on page 29.
- If such an amount of storage is possible from an operational standpoint, we found that the incremental costs of achieving net zero under this sensitivity would increase by three to four times above that of the net-zero scenario that utilizes natural gas (even without including the likely significant additional costs for transmission and distribution system upgrades). These costs could especially have an impact on Duke Energy's low- and fixed-income customers and energy-intensive businesses.

- Achieving net zero, even with gas, will require an unprecedented and sustained pace of capacity additions. For example, we will need to add new generation to our system over the next three decades at a pace more than double the rate at which we added generation over the past three decades. This is illustrated in the chart below.



- In the net-zero carbon scenario, renewables (solar and wind) contribute over 40,000 MW of those additions, representing 40 percent of the summer nameplate capacity of Duke Energy's system by 2050 and generating the largest portion of energy. To put this into perspective, Duke Energy's total summer generating capacity today is approximately 58,000 MW and grows to over 105,000 MW by 2050. The requirement for such large needed additions arises because replacing traditional electric generating capacity with renewables plus storage is not a one-for-one proposition. Due to the intermittency of renewables, significantly more capacity must be built, even with storage available, to provide the same level of reliable electricity generation as a fossil plant. Therefore, achieving net zero will also depend on our ability to site, construct and interconnect new generation, transmission and distribution resources at an unprecedented scale in a timely manner.[9]

[9] See University of North Carolina, "Measuring Renewable Energy as Baseload Power," March 2018. https://www.kenaninstitute.unc.edu/wp-content/uploads/2018/05/Kenan-Institute-Report-Measuring-Renewable-Energy-as-Baseload-Power-v2.pdf

- Our modeling demonstrates that if these resources are integrated into the grid as forecast, we will be able to serve customers under normal weather, which is the way we have planned the system in the past, when the vast majority of resources were dispatchable over long durations (weeks rather than hours). More work is needed to better understand the ability of renewables and storage to meet capacity needs, and how that will change as more of these resources are added to displace conventional generation. We are already embarking on these analyses and expect that collective industry understanding will improve over time.
- While we did not explicitly account for transmission and distribution needs in this analysis, it should be recognized that retirements of certain coal (and, later on, gas) units, as well as the addition of large volumes of renewables and energy storage, will require substantial investments in our transmission and distribution systems. Federal and/or state policy changes may be needed in order to achieve such large transmission and distribution investments in a timely manner.

The actual pathway that Duke Energy takes to achieve net-zero carbon emissions by 2050 will be based on the availability and cost of evolving technologies, federal and/or state climate policies, and stakeholder and regulatory input and approvals. During the 2020s, significant innovation and technological advancement will be critical to ensure we have viable technology options by the 2030s.

To help enable these new technologies, we are committed to working with the private and public sectors to drive research, development and demonstration of technologies such as advanced nuclear; carbon capture, utilization and storage (CCUS); hydrogen and biofuel utilization for power generation; and longer-duration (up to seasonal) storage.

We are embracing this extraordinary challenge, collaborating with regulators, policymakers and other stakeholders to help develop the best policies and options that will reduce carbon emissions and meet the needs of our customers for affordability, reliability and sustainability.

Zero-Emitting Load-Following Resources

Our analysis makes it clear that advanced very low- or zero-emitting technologies that can be dispatched to meet energy demand are needed for Duke Energy to transition to its net-zero carbon future. There are several technologies that could play the role of zero-emitting load-following resources (ZELFRs), such as:

- **Advanced nuclear** – Advanced nuclear includes a wide range of small modular light-water reactors (SMRs) and advanced non-light-water reactor designs. Small modular light-water reactors are closest to commercial deployment, with early designs targeting commercial operations in the mid-to-late 2020s. Advanced non-light-water reactor concepts are also under development and are expected to be commercially available in the 2030s.
- **Carbon capture, utilization and storage (CCUS)** – CCUS technologies for the power sector are in the early stages of deployment, with a few small-scale projects on coal having achieved commercial operation and several natural gas projects currently in development, spurred by the 45Q tax credit, which provides an incentive for utilizing or storing captured CO_2. Demonstration of CCUS at scale for natural gas power plants is an important milestone for commercial deployment in the power sector, as is building public, environmental and regulatory confidence around the transportation of captured CO_2 and its utilization and geologic storage.
- **Hydrogen and other gases (including renewable natural gas)** – Hydrogen and other low- or zero-carbon fuels are increasingly gaining attention for their potential to contribute to a net-zero carbon grid. For example, many existing natural gas turbines are already capable of co-firing hydrogen, and vendors are focused on developing models capable of firing 100 percent hydrogen. Key opportunities include cost-effectively producing hydrogen (or other gases, including renewable natural gas) from very low- or zero-carbon processes and ensuring safe and effective methods of transportation.
- **Long-duration energy storage** – Long-duration energy storage includes a wide range of thermal, mechanical and chemical technologies capable of storing energy for days, weeks or even seasons, such as molten salt, compressed/liquefied air, sub-surface pumped hydro, power to gas (e.g., hydrogen, discussed above) and advanced battery chemistries. These technologies are at various stages of research, development, demonstration and early deployment

Other technologies will also be important. We continue to explore pumped storage hydro opportunities (a mature technology), as well as advanced renewables (such as offshore wind and advanced geothermal and solar), energy efficiency and demand response.

Duke Energy is actively involved in efforts to advance research, development, demonstration and deployment of advanced technologies. For example, we are a founding member and anchor sponsor of the Electric Power Research Institute/Gas Technology Institute's Low Carbon Resource Initiative, which is a five-year effort to accelerate the development and demonstration of technologies to achieve deep decarbonization. And we have participated in extensive research over the past few years on CCUS, including, for example, a study of membrane-based carbon capture that was conducted at our East Bend facility in Kentucky. We are also involved in both the Midwest Regional Carbon Capture Deployment Initiative and the Midwest Regional Carbon Sequestration Partnership.

We are also a founding member of EEI's Clean Energy Technology Innovation Initiative, which is partnering with several non-governmental organizations (NGOs), including Clean Air Task Force, the Center for Climate and Energy Solutions, and the Bipartisan Policy Center, to identify areas for advocacy on advanced technologies.

Robust and sustained government support is vital to ensure the commercialization of these advanced technologies; Duke Energy will continue to advocate for sound public policies that advance this needed support.

Introduction

In the following sections, this report highlights Duke Energy's commitment to address climate change:

- **Governance** – discusses Board of Directors oversight, executive compensation and lobbying/ political expenditures policies.
- **Strategy** – discusses how various inputs inform and drive Duke Energy's plans to a net-zero carbon future.
- **Risk Management** – addresses Duke Energy's process for identifying physical and transition (policy and economic) risks, and measures for addressing these risks.
- **Metrics** – identifies the company's specific CO_2 reduction goals, progress toward those goals, as well as other greenhouse gas (GHG) metrics.
- **Scenario Analysis** – discusses our analysis of a net-zero carbon emissions scenario to provide insight into areas of near-term and longer-term focus needed to achieve our net-zero 2050 goal.

Governance

Board Committee Oversight

The Duke Energy Board of Directors understands the importance of climate change issues, as well as their significance to our employees, customers and communities, and recognizes the potential impact and opportunities for our business and industry. In 2019, the Board was instrumental in the development of Duke Energy's updated carbon reduction goals, including review and discussion at multiple meetings of the Corporate Governance Committee, along with insights from external experts at a full Board meeting.

Given the wide scope of climate risks, including physical, policy and economic risks, the Board and its committees are all actively involved in oversight, as shown in the table on the next page.

BOARD OF DIRECTORS
RISK MANAGEMENT OVERSIGHT STRUCTURE

Corporate Governance Committee

- Oversees risks related to sustainability, including climate risks
- Oversees risks related to public policy and political activities
- Oversees the company's shareholder engagement program, receives updates on shareholder feedback and makes recommendations to the Board regarding shareholder proposals, including those related to climate
- Evaluates the composition of the Board to ensure a proper mix of skills and expertise to oversee Duke Energy's risks and strategy

Finance & Risk Management Committee

- Oversees process to assess and manage enterprise risks, including climate risks (page 11)
- Oversees and approves major investments that are supportive of the company's climate strategy, such as renewables, grid modernization, natural gas and storage
- Oversees financial risks, including market, liquidity and credit risks

Operations & Nuclear Oversight Committee

- Oversees risks related to our nuclear fleet, our largest carbon-free resource, as well as risks related to our non-nuclear regulated operations
- Oversees operations and environmental, health and safety matters, including improvements at our generation facilities and coal ash basins to better withstand severe weather events (page 12)

Regulatory Policy Committee

- Oversees regulatory and policy risks related to climate change, including review of federal and state policies at every regularly scheduled meeting (page 15)

Compensation Committee

- Oversees risks related to our workforce and compensation practices, including those related to climate

Audit Committee

- Oversees the company's disclosures, internal controls and compliance risks, including those related to climate
- Oversees risks related to cybersecurity and technology

The day-to-day direct management of climate and carbon-reduction policies is the responsibility of the company's federal government and corporate affairs team. This team reports to the executive vice president for external affairs and president, Carolinas region, who is a member of the Duke Energy senior management team and reports directly to the chair, president and chief executive officer. The federal government and corporate affairs group has organizational responsibility for developing Duke Energy's position on federal legislative and regulatory proposals addressing climate change and greenhouse gas emissions and for assessing the potential implications of such proposals to the company – as well as for engaging stakeholders to help shape our climate strategy. In addition, Duke Energy's state presidents have responsibility for developing the company's positions on state-level legislative and regulatory proposals addressing climate change and greenhouse gas emissions, and for engaging stakeholders at the state level to help shape the company's climate strategy.

Compensation

The Compensation Committee has designed our compensation program to link pay to performance, with the goal of attracting and retaining talented executives, rewarding individual performance, encouraging long-term commitment to our business strategy and aligning the interests of our management team with those of our shareholders. The Compensation Committee has aligned several performance metrics with our sustainability strategy, including:

- Zero-carbon generation – We incorporate a nuclear reliability objective and a renewables availability metric in our short-term incentive plan to measure the efficiency of our nuclear and renewable generation assets.
- Environmental events – To enhance our commitment to the environment, we incorporate a reportable environmental events metric into our short-term incentive plan.
- Customers – To prioritize the customer experience and their growing demands to be served by cleaner energy, we incorporate a customer satisfaction metric in the short-term incentive plan, which is a composite of customer satisfaction survey results for each area of business.
- Safety – Safety remains our top priority. We include safety metrics in both our short-term and long-term incentive plans based on the total incident case rate of injuries and illnesses among our workers to emphasize our focus on an event- and injury-free workplace.
- Governance – We continue to incorporate sound governance principles and policies in our compensation program that reinforce our pay for performance philosophy and strengthen the alignment of interests of our executives and shareholders.

Duke Energy continues to review its compensation program performance metrics with the Compensation Committee.

Political Contributions and Lobbying

As a public utility holding company, Duke Energy is highly regulated and significantly impacted by public policy decisions at the local, state and federal levels. It is essential for us to engage in public policy discussions to protect the interests of Duke Energy, our customers, employees, shareholders and communities. Participation in public policy dialogues includes contributing to organizations, including trade associations, that advocate positions that support the interests of Duke Energy, our customers, employees, shareholders and communities.

Duke Energy has developed a robust governance program around our public policy engagement. The day-to-day management of our policies, practices and strategy with respect to public policy advocacy is the responsibility of the jurisdictional presidents at each applicable state level and our senior vice president for federal government and corporate affairs, who, along with other senior leaders across the company, make up a Political Expenditures Committee (PEC). The PEC is responsible for annually developing the company's political expenditures strategy and approving, monitoring and tracking our political expenditures. The company's Political Expenditures Policy sets out the principles governing corporate political expenditures and political action committee contributions. Under this policy, the senior vice president for federal government and corporate affairs provides a semi-annual update to the Corporate Governance Committee of the Board. This includes updates on the company's strategy and political expenditures, including payments to trade associations and other tax-exempt organizations that may be using the funds for lobbying and political activities. (See Duke Energy's Corporate Political Expenditure Reports).

In addition to our participation in trade associations for public policy engagement purposes, we participate in industry trade organizations for many non-political reasons as well, including business, technical and industry standard-setting expertise. As member-driven organizations, these trade associations take positions that reflect the consensus views of their members. We may not support each of the initiatives of every organization in which we participate or align in strategy with every position of every organization; however, in our interactions with them, we seek to harmonize the organizations' positions on climate change with those of Duke Energy. We believe our continued input into these discussions with organizations with whom we may not always totally agree enables us to educate others on our positions and enables us to better understand their positions.

Strategy

Informing Our View

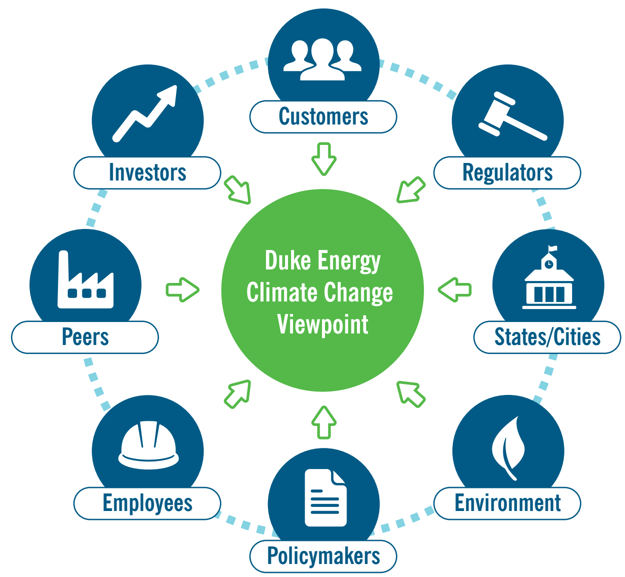
At Duke Energy, we are committed to leading in the effort to address greenhouse gas emissions and to build a cleaner, smarter energy future. As we talk with customers, investors and other stakeholders, reflected in the figure to the right, it's clear that they share that interest. It's also clear that unnecessarily compromising reliability and affordability, especially for our most vulnerable customers, is not an option.

An increasing number of our customers are calling for electricity from non-carbon-emitting sources. For example, Apple, BMW, Facebook and Google are all members of the "RE100," a coalition of companies committed to sourcing 100 percent of their electricity from renewable sources. In some cases, this is through a commitment to match 100 percent of the companies' electricity use with renewable energy purchases.

But it's much more than the interests of our large corporate customers. Counties and cities in Duke Energy's service territories have developed ambitious sustainability or 100 percent renewable energy goals, most by 2050. Further, North Carolina's governor issued an executive order followed by a Clean Energy Plan that calls for reducing greenhouse gas emissions from the power sector by 70 percent by 2030 and to achieve carbon neutrality by 2050. Additionally, climate change remains a prominent topic of discussion in federal political and policy arenas, as can be seen in proposals to address climate change being developed by Democratic and Republican leadership in Congress. The challenge inherent in these goals is not in their establishment, but rather in the development of the right mix of executable options to get the entire economy to net zero by 2050.

Climate change also continues to be a focus of engagement and discussion with the company's shareholders and employees. Both groups want to be sure we are recognizing and responding appropriately to the risks and opportunities that climate change presents.

To continue to power the lives of our customers, support the vitality of communities and exceed the expectations of our customers and stakeholders, we need to deliver energy that is cleaner and smarter than ever before.



Accelerating Our Carbon Reduction Goals

We recognize the long-term challenge climate change presents and that reducing CO_2 emissions in the power sector is a major part of the effort to address this challenge. Given the input discussed above, our assessment of climate-related risks and opportunities, as well as the declining cost of renewables and sustained low cost for natural gas, in 2019 we updated our carbon reduction goal. We are confident that we can achieve at least a 50 percent reduction in CO_2 emissions from electricity generation by 2030 compared to 2005 levels (a more aggressive target than our most recent 40 percent by 2030 goal).

We've also added a longer-term goal of achieving net-zero carbon emissions from electricity generation by 2050. Our goal to attain a net-zero carbon future represents one of the most significant planned reductions in CO_2 emissions in the U.S. power sector. It is also consistent with the scientifically based range of both 1.5 and 2 degrees Celsius pathways, as

discussed in the sidebar on page 30. Implementing this bold vision requires us to begin planning and executing now. The choices and investments we make near term will be foundational to achieving net zero by midcentury. Continuing to modernize our fleet and grid at a measured pace will help protect customers from dramatic price increases. At the same time, we must pursue innovation by advocating for sustained investments in low- and zero-carbon technologies for this vision to become reality.

Charting the Path

Achieving our carbon reduction goals will require at least five elements. We will continue to:

- **Collaborate and align with our states and stakeholders as we transform.** The steps and timeline for this transition will be unique in each state we serve, and we'll collaborate with customers, communities, policymakers and other stakeholders to determine the best path.
- **Accelerate our transition to cleaner energy solutions.** We're planning to at least double our portfolio of solar, wind and other non-hydroelectric renewables by 2025. We'll continue to need dispatchable, load-following, low-cost natural gas to speed the transition from coal and maintain affordability and reliability. New natural gas infrastructure will be required to fuel this transition and balance renewables. We'll continue expanding energy storage, energy efficiency, as well as electric vehicle infrastructure to support decarbonization of the transportation sector, now the largest CO_2-emitting sector.
- **Continue to operate our existing carbon-free technologies, including nuclear and renewables.** Our nuclear fleet's nearly 11,000 MW of carbon-free generation in the Carolinas – enough to serve nearly 7 million homes – is central to our ability to meet these goals. In September 2019, we announced that we will seek to renew the operating licenses of the 11 reactors we operate at six nuclear stations for an additional 20 years, which will extend their operating lives to and beyond midcentury.
- **Modernize our electric grid.** The company is investing in a multiyear effort to create a smarter and more resilient grid that can protect against extreme weather and cyber or physical attacks. These grid improvements also support adding more renewables while avoiding outages and providing customers more control over their energy use.
- **Advocate for sound public policy that advances technology and innovation.** This includes advanced renewable energy, longer-duration (up to seasonal) storage, new nuclear technologies, low- and zero-carbon fuels and effective ways to capture carbon emissions. The company will also support permitting reforms that will enable the deployment of new technologies and construction of critical infrastructure, both needed to address climate change.

As we partner with customers, policymakers, regulators and stakeholders in our respective states to make our transition, our integrated resource plans, financial plans and other regulatory filings will progressively reflect our proposed path (in accordance with the time frames mandated for each).

Physical Risk

Adaptation
Preparing for change

- Water Conservation
- Storm Preparation

Policy Risk

Mitigation
Slowing the change

- Reducing Greenhouse Gas Emissions
- Conservation

Economic Risk

Innovation
Outsmarting the change

- System Modernization
- New Technology

For example, Duke Energy has already retired 51 coal units totaling more than 6,500 MW since 2010, and we plan to retire an additional 900 MW by the end of 2024. In rate cases filed in 2019, we proposed to shorten the book lives of another approximately 7,700 MW of coal capacity in North Carolina and Indiana. We are also converting three of our largest coal plants in the Carolinas to run partially or fully on natural gas, providing resiliency and reducing carbon emissions. We recognize the importance of our power plants to the communities that host them and the workforce that operates them. As we retire coal plants, we will continue to strive to transition impacted employees to new opportunities and will work to match communities with appropriate resources.

Taking a Comprehensive Approach

Addressing the complex challenge of climate change requires more than just carbon emissions reductions. Our holistic approach to addressing physical and transition (policy and economic) risks associated with climate change includes three key areas of focus: adaptation, mitigation and innovation.

- Adaptation – Duke Energy is taking steps to prepare for the changing global climate, including water conservation and storm preparation.
- Mitigation – We are working to slow climate change with a variety of carbon reduction and land conservation efforts.
- Innovation – Duke Energy is helping drive the new technologies necessary for a net-zero carbon future.

Risk Management

Our Approach

Climate change risks – including physical and transition (policy and economic) risks – are included in the company's Enterprise Risk Management (ERM) process. The ERM process is used to identify, assess, quantify and respond to a comprehensive set of risks in an integrated and informed fashion. ERM provides a framework to manage risks while achieving strategic and operational objectives and continuing to meet the energy needs of our customers.

Duke Energy performs a comprehensive enterprise risk assessment on an annual basis to identify potential major risks to corporate profitability and value, including risks related to climate change. To inform the annual risk assessment, the ERM group works with subject matter experts to identify and characterize key risks, including climate- and environmental-related risks. In addition, our chief risk officer meets with business unit leadership to discuss risks on a quarterly or semi-annual basis. The ERM group shares the annual enterprise risk assessment with the Board and reports regularly to the Finance and Risk Management Committee.

To assure Duke Energy is incorporating climate, technology and economic risks into our long-term planning, we annually, biennially or triennially (depending on the state) prepare forward-looking integrated resource plans (IRPs), or similar regulatory filings, for each of our regulated electric utility companies. These 10- or 20-year plans help us evaluate a range of options, considering forecasts of potential future climate policies, future electricity demand, fuel prices, transmission improvements, new generating capacity, integration of renewables, energy storage, energy efficiency and demand-response initiatives.

In recognition of the increasing role of distributed energy resources, the company is expanding its planning and is developing new Integrated Systems and Operations Planning (ISOP) tools that will inform and evolve the current IRP process. This effort will significantly enhance the coordination of modeling and analysis across generation, transmissions, distribution and customer program planning functions. ISOP is motivated by the expectation that advancements in technology and declining costs will make non-traditional solutions such as energy storage increasingly competitive relative to traditional resources. ISOP will include enhancements to modeling processes necessary to accommodate renewable growth and value new technologies, such as energy storage, electric vehicles and advanced customer programs. In the areas of distribution planning, ISOP builds on our objective of enabling higher levels of distributed energy resources by developing planning tools that can fully leverage the intelligent grid control capabilities of our grid modernization efforts.

Physical Risks

Extreme weather events – including hurricanes, heavy rainfall, more frequent flooding and droughts – can impact our assets, electric grid and reliability. Due to the location of some of our service territories, we must be especially vigilant about adapting to these risks.

Storms and Heavy Rainfall Events

We are making strategic improvements to make the power grid more resistant to outages from severe weather and flooding, and adding new technologies that make the grid more resilient:

- Upgrading utility poles and power lines to make them more resistant to power outages and able to withstand higher winds and more extreme conditions.
- Using data to identify the most outage-prone lines on our system and placing those lines underground. In Florida, we recently announced a ten-year plan to underground and make other improvements to power lines that run through heavily-vegetated areas, and have stated a goal of either undergrounding or hardening all feeders and laterals by 2050. We are also upgrading underground routes to allow for more remote restoration opportunities.
- Installing a smart-thinking grid that can automatically detect power outages and quickly reroute power to other lines to restore power faster than ever. In 2019, self-healing technologies prevented more than 600,000 extended outages across the company's six-state electric service area and saved customers more than 1 million hours of total outage time.

We have developed mitigation measures that are being installed to keep substations better protected and in operation during severe storms. These measures include:

- Improved barriers that better withstand flooding to keep these essential systems operating.
- Targeted relocation of equipment – while barriers are usually the most effective solution, in some instances we will relocate equipment to nearby property that is outside the area prone to flooding.
- Remote communication, monitoring and restoration capabilities – we are installing new technology to monitor the health of key systems in substations, as well as self-healing capabilities that can help to reduce the number of customers impacted by a substation outage, even if crews are not able to physically reach the substation.

We have made improvements at our power plants to ensure they are capable of withstanding heavy rainfall events and flooding. For plants near the coast, these actions also help protect against potential sea level rise impacts:

- Raised the foundation of the new Citrus Combined Cycle Station in Florida to protect the station from hurricane storm surges.
- Increased structural hardening and improved equipment protection at the Brunswick Nuclear Station in North Carolina to better resist flood impacts.

- Evaluated and prioritized our fossil sites for possible flood risks and performed detailed modeling of the top four sites against 100- and 500-year storms and riverine flooding; additionally, updated our site-specific natural disaster preparation procedures.

In addition to our extensive mutual assistance partnerships with other utilities and contractors to bring additional resources in quickly to support our crews responding to major outage events, we have also improved our storm preparation and response capabilities:

- Improved storm and damage forecasting capabilities enable us to stay ahead of the storm, identifying likely areas of impact and moving resources into place ahead of the storm to respond faster.
- The use of drones to better assess damage and support crews in the field.
- Improved communication and control capabilities to give crews in the field more information and assistance when they need it.
- Improved customer communication tools to help keep customers informed about outage response and estimated times of restoration.

Water Availability

Many sources of electricity require significant amounts of water for cooling purposes.
A prolonged drought could therefore risk reliable electricity generation.

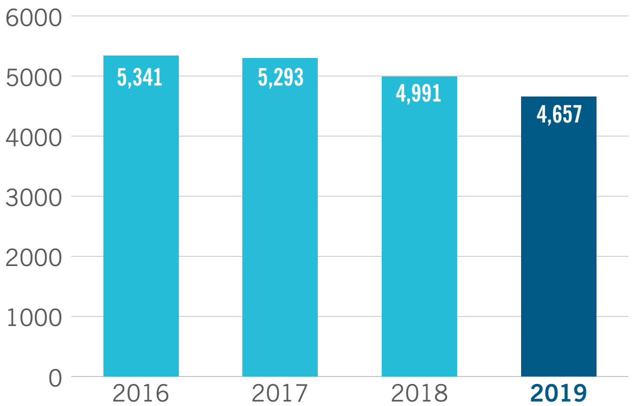
Several of Duke Energy's fossil and nuclear power plants in the Carolinas are located on hydroelectric reservoirs that the company operates. Of course, water availability is an important consideration in those watersheds, both to Duke Energy and to others. In these areas, we collaborate with local water utilities, environmental groups and recreation enthusiasts on watershed and drought planning. Our hydroelectric projects also have drought response plans (known as "low inflow protocols" (LIPs)) embedded in their Federal Energy Regulatory Commission (FERC) operating permits; the LIPs work to conserve water in the reservoirs and protect all water intakes in the watershed, including those for Duke Energy's facilities, until it rains again. Duke Energy's hydroelectric projects also have procedures in place for managing operating conditions during "high inflow" (high rainfall) events.

Except for emergency situations, Duke Energy endeavors to maintain lake levels within the ranges set forth in its FERC licenses under normal operating conditions. Lake levels are closely monitored, and operational adjustments are made based on various factors, including weather forecasts.

Other Duke Energy facilities are protected from drought because they have closed-cycle cooling and/or operate on large sources of water or on cooling reservoirs; one (the Brunswick Nuclear Station) withdraws water from an estuarine environment and so is not susceptible to drought-related risks. We have also implemented equipment and operational changes at nuclear and coal plants to reduce potential drought-related risks.

In 2018, we adopted a new goal to reduce annual water withdrawals by our generation fleet by 1 trillion gallons from the 2016 level by 2030.

Water Withdrawn for Electric Generation (billion gallons)



Our transition to cleaner energy by replacing coal and natural gas plants that use once-through cooling systems with natural gas combined-cycle plants that use closed-cycle cooling systems, and with renewables, reduces the amount of water withdrawn and thereby reduces the risk to operations from potential future droughts.

Ash Management Program

Duke Energy has instituted a comprehensive ash management program that ensures that waste facilities, which are typically located at generating stations near waterbodies for cooling water, operate properly even in extreme weather. Scientific studies of our ash basins and landfills, dam safety inspections, emergency planning, ongoing environmental monitoring efforts and more – performed by the company and independent experts – address the operational, environmental, strategic and financial risks associated with effectively managing coal ash today and for decades to come.

Permanently closing ash basins is the most effective step we can take to address climate risk. The scope, scale and speed of the company's work to close basins make us an industry leader. Under our comprehensive ash management plan, we have:

- Completed extensive ash basin and cooling pond dam improvements across our fleet, which have enhanced dam safety and provide greater protection from severe weather.
- Stopped all flows into ash basins as part of the coal ash basin closure process (except at the Gallagher plant, which will retire in 2022), and the basins are being dewatered. This and other closure preparations have dropped the level of water in the basins significantly, creating space to accommodate significant rainfall.
- Excavated nearly 28 million tons of ash enterprisewide since basin closure began, with more than 5 million tons moved in 2019 alone. We have completed excavation of the basins at our Dan River, Sutton and Riverbend stations. As announced in January 2020, Duke Energy, state regulators and community groups agreed to a plan to permanently close the company's remaining coal ash basins in North Carolina primarily by excavation.

We are also utilizing operational experience and best practices from across the industry to modify and improve our facilities.

- Prior to severe weather, the company takes several steps to prepare for potential ash basin response, including pre-staging equipment and trained professionals, actively reducing water levels if needed and placing construction materials on-site to respond quickly if repairs are necessary.
- At the retired Sutton Plant in Wilmington, a special synthetic turf rated to withstand hurricane-force winds is being used to cap each landfill cell because it provides additional protection against erosion and strong winds that occur in the region.
- We've expanded or built new emergency spillways at cooling ponds at three facilities near the coast (H.F. Lee, Weatherspoon and Sutton) to safely move water through the system if necessary in order to prevent damage to the facilities. The company has robust emergency action plans for each facility covering ash basins and certain dams, which detail specific protocols to address a variety of situations, including severe weather events. These plans are reviewed annually with emergency managers and first responders, shared with regulators and updated as needed.

Policy Risks

Federal or state policies could be enacted to put a legal constraint on power plant emissions, add a price on carbon or mandate certain energy mixes. Other policies may be needed to enable our net-zero transition, such as those to facilitate the siting and cost recovery of needed transmission and distribution upgrades.

Since the publication of our 2017 Climate Report, the U.S. Environmental Protection Agency repealed the 2015 Clean Power Plan and finalized its replacement, the Affordable Clean Energy (ACE) rule. States will determine how the rule will be implemented, so we will better understand any potential impacts to our system once states finalize their plans over the next two years.

In addition, several bills have been introduced in the 116th Congress that seek to establish a price on CO_2 emissions, and House Energy and Commerce Committee leadership has introduced the Climate Leadership and Environmental Action for our Nation's (CLEAN) Future Act. This draft legislation includes a mandate to transition to 100 percent clean electricity by 2050. Other legislative approaches provide substantial support for the development of technologies needed for the net-zero transition, such as the American Energy Innovation Act. It is unclear when or if any of these proposals will be enacted by Congress.

Federal policymakers could also impose mandates that restrict the availability of fuels or generation technologies – such as natural gas or nuclear power – that enable Duke Energy to reduce its carbon emissions.

At the state level, the North Carolina governor recently directed the development of a state Clean Energy Plan that proposes to explore a variety of policies and actions that will seek to reduce carbon emissions, modernize the utility regulatory model and advance clean energy economic development opportunities. The North Carolina Clean Energy Plan calls for a 70 percent reduction in greenhouse gas emissions in the power sector by 2030 and aims to achieve carbon neutrality by 2050. Duke Energy is actively participating in the stakeholder process to inform and shape the final policy proposal. The stakeholder process is currently slated to provide recommendations to the governor by year-end 2020. It is likely that proposals generated through the process would require legislative or regulatory action to be adopted.

In Indiana, legislation was enacted in 2019 that established a 21st Century Energy Policy Development Task Force. The task force is comprised of members of the House and Senate as well as gubernatorial appointees representing various energy-related stakeholders. The statute requires the Indiana Utility Regulatory Commission (IURC) to examine Indiana's future energy resource needs; existing policies regulating electric generation portfolios; how shifts in electric generation could impact reliability, resilience and affordability; and whether state regulators have appropriate authority regarding these matters. This report is due in July 2020. The IURC has a contract with Indiana University for a second study, not required by statute, to examine the impact

of plant closures on local communities. The task force's recommendations are due to be reported to the General Assembly and the governor by December 2020.

Duke Energy has long advocated for climate change policies that will result in reductions in CO_2 emissions at reasonable costs over time. We support market-based approaches that balance environmental protection with affordability, reliability and economic vitality.

Duke Energy's View on Effective Carbon Policy

It's our view that effective policies to reduce CO_2 emissions should include these principles:

- Cost-effective
- Market-based
- Equitable
- Provisions for all emitting sectors
- Environmentally effective
- Promotes technology development
- Politically sustainable

While it is unclear what specific policies will receive formal consideration in Congress, our analyses have identified some key policy attributes that we believe will allow us to achieve our net-zero goal while allowing us to maintain lower costs for our customers. These attributes will also help to incentivize the adoption of new, low- and zero-emitting technologies. Therefore, we believe climate policy should:

- Incentivize a zero-carbon trajectory at the lowest cost, rather than simply imposing a price or dictating a certain generation mix.
- Recognize that nuclear and natural gas generation remain essential to transitioning to an affordable and reliable net-zero carbon future.
- Recognize that regardless of whether (and which) market-based mechanism is adopted, robust and sustained support for research, development, demonstration and deployment of advanced technologies is critical.

Duke Energy factors policy risk into our strategies by evaluating carbon price scenarios in the development of our integrated resource plans. Since 2010, Duke Energy has included a price on CO_2 emissions in our IRP planning process to account for potential climate legislation or regulation. Incorporating a price on CO_2 in our IRPs allows us to evaluate existing and future resource needs against a potential climate change policy risk in the absence of policy certainty. We use a range of potential CO_2 prices (including no CO_2 price) to reflect a range of possible policy outcomes.

Other policies may be needed to enable our zero-carbon transition. For example, without streamlined permitting of transmission and distribution, the buildout of large volumes of renewables and energy storage will be a greater challenge.

Economic Risks

Our continued efforts to drive carbon out of our regulated electric utilities' operations help mitigate Duke Energy's financial exposure to potential future climate legislation or regulation. However, potential regulations or legislation to address climate change may require Duke Energy's regulated electric utilities to make additional capital investments to comply and could increase operating and maintenance costs. (Our commercial unit, Duke Energy Renewables, is already 100 percent carbon-free.) As with costs incurred for complying with other types of environmental regulations, our regulated electric utilities would plan to seek cost recovery for investments related to carbon reduction through regulatory rate structures.

To mitigate the risk of stranded assets, we will engage with regulators – and with stakeholders – prior to retiring existing assets or making investments in new generating capacity. This robust regulatory approach supports our future ability to recover costs as we position our fleet for the transition to lower carbon emissions.

Another area of economic risk for our strategy is technology risk. As noted earlier, a critical part of our net-zero carbon strategy is the need for new technologies that are not yet commercially available or are unproven at utility scale. If these technologies are not developed or are not available at reasonable prices, or if we invest in early-stage technologies that are then supplanted by technological breakthroughs, Duke Energy's ability to achieve a net-zero target by 2050 at a cost-effective price could be at risk.

To reduce this risk, we are investing in new technology research, including the Electric Power Research Institute/Gas Technology Institute's Low Carbon Resource Initiative, which is a five-year effort to accelerate the development and demonstration of technologies to achieve deep decarbonization.

We also support policies to increase technology research, development, demonstration and deployment at the federal level. For example, Duke Energy has supported, on its own and through trade associations, including the Edison Electric Institute and the Nuclear Energy Institute, a package of technology-promoting legislation in the 116th Congress.[10] We are also a founding member of EEI's Clean Energy Technology Innovation Initiative, which is partnering with several NGOs, including Clean Air Task Force, the Center for Climate and Energy Solutions, and the Bipartisan Policy Center, to identify areas for advocacy on advanced technologies.

As we deploy increasing amounts of renewables, siting risk becomes a consideration – both for the renewables themselves and for the transmission infrastructure needed to enable the energy generated to travel to load centers. This could force Duke Energy to adopt more expensive or less optimal (from an operational standpoint) options.

Climate policies or activities to mitigate physical risks can add material costs to the price of electricity and customer bills. This could in turn affect projected electricity utilization increases (such as from growth in demand and electrification of other sectors), as well as Duke Energy's most vulnerable customers.

Another area of economic risks is risks related to insurance. Property insurance companies have said publicly that they intend to stop providing insurance to companies that have above a certain amount of coal generation, or have said that they will only provide coverage if a company has a plan to decrease that over a reasonable period of time.[11] As noted above, Duke Energy has retired significant amounts of coal capacity and has plans to retire more. The below discussion of our strategy to meet our net-zero CO_2 emissions goal shows that coal will be phased out of our generation fleet.

Opportunities

Duke Energy is focused on the challenges climate change presents. We stand ready to meet those challenges while also recognizing concern about climate change can mean opportunities for our regulated electric utilities to make investments in renewables, energy efficiency, energy storage,

[10] See October 3, 2019, letter from Edison Electric Institute, the Nuclear Energy Institute and 26 other trade organizations to leaders McConnell and Schumer supporting a package of seven technology-promoting bills; October 15, 2019, letter to Speaker Pelosi and leaders McCarthy, McConnell and Schumer from Duke Energy and 24 organizations and companies supporting the Nuclear Energy Leadership Act; and March 2, 2020, letter from EEI, NEI, the U.S. Chamber of Commerce and 36 other organizations supporting the S. 2657, the American Energy Innovation Act.

[11] See, for example, "Liberty Mutual to Limit Coal Underwriting, Investments; Names First Sustainability Officer," Insurance Journal, December 16, 2019.

grid modernization, as well as in electric vehicle infrastructure. Duke Energy's commercial renewables business can benefit from increased interest in renewables throughout the country. And new technologies to reduce emissions represent both a risk and an opportunity.

Renewable Energy

Customer demand for electricity from renewable sources has increased due, in part, to concerns about climate change. Duke Energy has responded with initiatives in both its regulated and commercial renewables businesses and will continue to seek additional opportunities. In addition, regulatory or legislative policies related to climate change can prove to be a driver for opportunities for increased deployment of renewable generation sources.

Our commercial renewables business, Duke Energy Renewables, operates wind and solar generation facilities across the U.S., with a total electric capacity of approximately 4,000 MW. The power produced from commercial renewable generation is primarily sold through long-term contracts to utilities, electric cooperatives, municipalities, and commercial and industrial customers. Our five-year capital plan, rolled out in February 2020, included a $2 billion investment, net of tax equity financings, and we plan to continue to invest in this business beyond the next five years.

Opportunities for increased renewable energy also benefit our regulated generation business, where we have installed and are operating approximately 460 MW of solar and anticipate at least 660 MW to be added in the next three years. We also purchase substantial amounts of renewable energy in the form of long-term purchased power contracts, backed by the strength of our balance sheet. These purchases totaled nearly 4,000 MW at the end of 2019, and we are projected to add nearly 2,300 MW in the next three years.

Policies have also been approved in several of our states to encourage increased use of renewable energy, including, for example, our Green Source Advantage program for renewable energy in North Carolina (to which the city of Charlotte has signed on) and the Renewable Energy Credit (REC) Solutions programs in several of our regulated jurisdictions (in the latter, we work with large customers to procure RECs to meet their renewables needs).

Energy Efficiency

Some of the most effective carbon reductions we can make involve helping customers avoid energy usage in the first place. Again, regulatory or legislative policies related to climate change can prove to be a driver for opportunities for increased deployment of energy efficiency. These opportunities are available for both our regulated and commercial businesses.

Our Carolinas utilities rank first in the Southeast in energy efficiency.[12] Our overall energy efficiency initiatives have helped customers in our regulated jurisdictions reduce energy consumption and peak demand by nearly 19,000 gigawatt-hours and 6,700 MW, respectively, since 2008. This cumulative reduction in consumption is more than the annual usage of 1.58 million homes, and the peak demand reduction is equivalent to more than 10 power plants each producing 600 MW. Learn more about energy efficiency.

Energy Storage

Battery storage and microgrids are key technologies that can help better integrate solar into the grid while, among other uses, improving customer reliability and grid security, as well as reducing economic impacts to customers through the ISOP framework described above. Duke Energy plans to invest roughly $600 million over the next five to 10 years to expand battery storage by almost 400 MW. The company also has more than 2,000 MW of pumped storage hydro power, another energy storage method that can provide long-term storage. We plan to install upgrades at our Bad Creek pumped storage hydro facility in South Carolina to increase its capacity by more than 300 MW.

Grid Modernization and Infrastructure Expansion

Climate change presents opportunities for Duke Energy to continue to modernize its grid to benefit customers both for resilience against the physical risks from climate change and for increased utilization of renewables. This opportunity can mean increased investments in both transmission and distribution assets, as well as in energy storage, as discussed above.

[12] Southern Alliance for Clean Energy, "Energy Efficiency in the Southeast: 2019 Annual Report," January 2020, https://cleanenergy.org/blog/energy-efficiency-in-the-southeast-2019-annual-report/.

Smart meters are just one example of how Duke Energy is working to modernize the grid for the benefit of our customers. Duke Energy has installed smart electric meters for more than 80 percent of its customers. With these meters, and time-of-use rates, customers can plan their energy use so that they can save energy and money. Time-of-use rates encourage customers to use energy when demand is lower, which can make energy more affordable for customers while helping the company maintain reliability during peak periods. The company is currently piloting several new time-of-use rates in North Carolina and has proposed several variations of pilot programs in Indiana. These pilots are designed to work in conjunction with newly-installed smart meters to provide price signals at times of peak demand to customers. The pilots will allow the company to develop new, cutting-edge rate designs that will work with renewables and electric vehicles.

Electric Vehicles

Part of our contribution to reducing overall greenhouse gas emissions also involves helping lower emissions from the transportation sector. We've proposed a bold $76 million initiative in North Carolina, to date the largest investment in electric vehicle infrastructure in the Southeast. This will include nearly 2,500 new charging stations that will lead to a statewide network of fast-charging stations and will help fund the adoption of electric school buses and electric public transportation. Similar pilot programs are being considered by regulators in South Carolina ($10 million), Indiana ($10 million), Ohio ($16 million) and Kentucky ($3 million). We also expect to have installed more than 500 charging stations in Florida by 2022. Duke Energy is also adopting electric vehicles into its fleet, having acquired roughly 600 vehicles thus far. Learn more about the benefits of electric vehicles.

New Technologies

To get to net-zero carbon emissions, while keeping energy affordable and reliable, new technologies that are economically competitive at commercial scale are necessary. Technologies such as CCUS, longer-duration (up to seasonal) energy storage, new nuclear technologies, and yet-to-be-imagined discoveries, as well as innovative use of greener fuels such as renewable natural gas and hydrogen will be important. To take advantage of these opportunities, we are supporting policies that will advance new technologies and investing in research and development for these important innovations, as discussed on page 5.

Metrics and Targets

Greenhouse gases (GHG) emitted by Duke Energy facilities include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and sulfur hexafluoride (SF_6). The burning of fossil fuels to generate electricity is by far the primary source of Duke Energy's GHG emissions, producing emissions of CO_2, CH_4 and N_2O. The other sources of Duke Energy GHG emissions include CH_4 emissions from natural gas distribution operations, and emissions of SF_6, an insulating gas used in high-voltage electric transmission and distribution switchgear equipment.

As of year-end 2019, Duke Energy has reduced CO_2 emissions 39 percent from electricity generation since 2005, ahead of the industry average of 33 percent.[13] In 2019, we accelerated our carbon reduction goal from 40 percent to more than 50 percent by 2030. We also added a longer-term goal of achieving net-zero carbon emissions by 2050. Progress toward our CO_2 and other sustainability goals will continue to be updated on an annual basis in our Sustainability Report.

In the following tables, we adhere to the World Resources Institute/World Business Council for Sustainable Development Greenhouse Gas Corporate Protocol Standard, which classifies a company's GHG emissions into three "scopes." Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy (that is consumed by the reporting company). Scope 3 emissions are all indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company.[14]

Scope 1 Emissions

Greenhouse Gas Emissions from Electricity Generation (thousand short tons CO_2 equivalent (CO_2e))

	2005	2017	2018	2019	2030 Goal	2050 Goal
CO_2	153,000	105,000	105,000	93,000	76,500 *(At least 50% below 2005)*	Net-zero
CH_4[15]	420	230	218	189	–	–
N_2O[16]	731	391	369	365	–	–

All data based on ownership share of generating assets as of December 31, 2019.

Methane Emissions from Natural Gas Distribution (thousand short tons CO_2e)

	2016	2017	2018	2019
CH_4	184	175	176	185

Sulfur Hexafluoride Emissions from Electric Transmission and Distribution (thousand short tons CO_2e)

	2016	2017	2018	2019
SF_6	573	536	337	535

SF_6 emissions fluctuations are due to maintenance, replacement and storm repair needs.

[13] U.S. Energy Information Administration, *Monthly Energy Review*, March 26, 2020.
[14] See https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf.
[15] No goal is established for methane emissions from electricity generation – see methane sidebar.
[16] No goal is established for N_2O emissions from electricity generation; emissions of this gas will decline with reductions in fossil fuel use.

Reducing Methane Emissions

Duke Energy has been an industry leader in driving down methane emissions. Since 2001, Duke Energy's Piedmont Natural Gas unit has been a member of EPA's Natural Gas STAR program, which emphasizes best management practices to voluntarily reduce methane emissions and report those reductions. In 2016, all of Duke Energy's gas operations became founding members of EPA's Methane Challenge.

Duke Energy is also monitoring, through its memberships in the Edison Electric Institute (EEI) and the American Gas Association (AGA), the development of the EEI/AGA Natural Gas Sustainability Initiative (NGSI), an initiative that focuses on the measurement and disclosure of methane emissions throughout the entire natural gas supply chain.

To reduce methane emissions and improve the safety and reliability of the natural gas system in Ohio and Kentucky, Duke Energy implemented the Accelerated Main Replacement Program (AMRP) in 2000. The program's purpose was to replace cast iron and bare steel pipelines (and associated services) with plastic or coated steel pipe.[17] The program was completed in Kentucky in 2010 and in Ohio in 2015. Piedmont Natural Gas had already completed a similar program when it merged with Duke Energy in 2016. We also recently completed an accelerated service line replacement program in Kentucky in which approximately 30,000 service lines were replaced. In total, Duke Energy's Natural Gas Business Unit has replaced 1,454 miles of cast iron pipe on its distribution system with either plastic or cathodically protected steel.

It should be noted that the methane emissions we report above (a total of less than half of one percent (0.5%) of our CO_2 emissions from electricity generation, on a CO_2 equivalent basis) are, as required by EPA, based on EPA emissions factors. For emissions from electricity generation, EPA emission factors are applied to the amounts of the various fossil fuels we combust. For emissions from our natural gas distribution system, methane emissions are calculated by applying EPA emission factors (for different pipe materials) to the miles of natural gas pipelines we operate, and to the number of services. We also quantify leaks based on leak survey data. Given this, as our natural gas distribution system expands, emissions (all other things being equal) will tend to increase. We are carefully evaluating our sources of methane emissions and potential avenues to reduce them further.

[17] In natural gas parlance, "service" means the service pipe that carries gas from the main pipe to the customer's meter.

Scope 2 and 3 Emissions

In 2019, Duke Energy reported to CDP (formerly known as the Carbon Disclosure Project) 25,600 tons of Scope 2 CO_2 equivalent emissions for 2018. These are estimated from power purchases for Duke Energy facilities that are not served by Duke Energy itself.

In 2019, Duke Energy reported to CDP the following categories of Scope 3 CO_2 equivalent emissions for 2018:

Category	Thousand short tons CO_2e
Fuel and energy-related activities (not reported in Scope 1 or 2). This is an estimate of CO_2 emissions associated with electricity Duke Energy purchased for resale.	11,122
Use of sold products. These are CO_2 emissions from the use of natural gas that Duke Energy delivers to its end-use customers.	19,811

Net-Zero Scenario Analysis

The following analysis examines a scenario, including sensitivities, for achieving our net-zero CO_2 emissions goal by midcentury, along with the potential impacts on the generation portfolio of our regulated electric utilities. This analysis was conducted using the same industry-standard expansion planning and hourly production cost modeling tools that we use for integrated resource planning. The analysis, however, did not include transmission and distribution modeling that would be required to assess cost and technical feasibility of interconnecting such large quantities of renewables with operational feasibility.

It should be emphasized that the scenario analysis presented is intended only to provide an enterprisewide directional illustration of the impact of changes in the generation fleet. The results presented are indicative of potential options to meet Duke Energy's targets but **do not represent specific utility resource plans and will change over time as new information becomes available**. We will work collaboratively with stakeholders and regulators in the states we serve as we develop future resource plans pursuant to regulatory requirements.

Key Assumptions and Considerations

Any analysis that goes out three decades includes numerous uncertainties and assumptions. Because it is based on currently available technology and cost information, the company's IRP process provides a relatively more certain view through 2030. Projecting beyond that time frame requires assumptions for how technology, electricity demand and costs may evolve several decades in the future. To follow the spirit of the IRP process in the modeling from 2030 to 2050, the technologies considered were limited to those in which we have reasonably high confidence in their likely commercial availability and in current projections of their costs. With those caveats, our net-zero scenario analysis makes the following assumptions:

NET-ZERO SCENARIO ASSUMPTIONS	
System Load	Average annual increase of 0.46 percent from 2020 to 2050. This is based on an EPRI study done for the Carolinas that assumes significant adoption of energy efficiency measures in buildings and industry, resulting in flat electricity demand through 2050 (offsetting all load growth due to new customers).[18] On top of this, the study assumes significant transportation electrification, resulting in the 0.46 percent per year load growth we assume here. While this study was done for the Carolinas, similar adjustments in the load forecast were applied to all our jurisdictions.
Existing Nuclear	All existing nuclear capacity is relicensed and authorized to operate for an additional 20 years (for a total operating life of 80 years). Existing nuclear generation is assumed to be capable of reducing output by up to 20 percent to aid in balancing generation and load.
Accelerated Coal Retirements	All coal units in the Carolinas, except those that have been or are being modified to run fully or partially on natural gas, are retired by 2030. All remaining coal units except the Edwardsport Integrated Gasification Combined Cycle plant are retired by 2040. Edwardsport is retired by 2045. For the net-zero carbon scenario, Cliffside 6 was assumed to operate exclusively on natural gas by 2030, until its retirement in 2048. Note that these are modeling assumptions and do not necessarily match retirement dates filed in regulatory proceedings. Future resource plans will be developed working collaboratively with stakeholders and regulators in the states we serve, pursuant to regulatory requirements.
Natural Gas Assets	To test the economics of the model, all natural gas combined-cycle units built in the 2020s are assumed to have a 20-year book life. Beyond 2030, all natural gas additions are assumed to be combustion turbines ("peakers") only. We also explored a sensitivity where no new natural gas electricity generation was added.
Markets	No market Regional Transmission Organization energy purchases or purchased power agreements are assumed beyond 2035 due to the uncertainties of how the markets and other utilities' resource plans will evolve that far into the future. This is a conservative approach to ensure that customer load is served. Actual plans would consider market purchases if they were the most economical.
Fuel Prices	Coal prices are projected to continue to remain low into the future, but a slightly higher, though still relatively low, natural gas price trajectory in the near- to mid-term continues to support gas as baseload or intermediate generation ahead of coal. Nuclear prices remain low relative to both coal and gas and support continued operation of Duke Energy's existing nuclear fleet.

[18] Electric Power Research Institute, "North Carolina Efficient Electrification Study: Task 1 Energy System Assessment," November 2019.

Technology Prices[19] (approximate overnight capital costs)	▪ Combustion Turbines – \$550/kilowatt (kW) (represents multi-unit site) ▪ Combined Cycle – \$650/kW (represents 2x1 advanced class) ▪ Small Modular Nuclear Reactor – \$5,500/kW ▪ Natural gas combined cycle (NGCC) with CCUS – \$2,000/kW (cost is at the fence line; cost to transport CO_2, which is highly dependent on location, as well as the cost of injection, would be additional) ▪ Solar – \$900/kW ▪ Wind – \$1,300/kW (on shore) to \$2,400/kW (offshore) ▪ Pumped storage hydro – \$2,500/kW (existing reservoirs) ▪ Lithium-ion storage – \$900/kW (4 hour) to \$1,600/kW (8 hour) – consistent with the NREL annual technology baseline and excludes allowance for degradation, limits of depth of discharge, and owners and interconnection costs **NOTES:** Interconnection costs for these technologies were not explicitly considered in the scenario analysis. This assumption yields an optimistic view of the costs of adding large quantities of renewables to the grid. Typical costs of transmission access for various types of renewables are shown below as a percentage of total project costs: ▪ Conventional generation – 10 percent (constrained area) ▪ Solar – 20 percent (bundled solar in constrained area) ▪ Wind (offshore and out of state) – 25-50 percent (location-dependent) ▪ Batteries – 20 percent (depends on location and primary use) Transmission access cost is expected to increase with greater amounts of renewables and will be dependent on location, type, amount and existing infrastructure. Due to uncertainty in these factors, projections of future transmission access costs were not included.

[19] These prices are in line with NREL's Annual Technology Baseline: https://atb.nrel.gov. Escalations are based on the Energy Information Administration's Annual Energy Outlook 2019.

Battery Storage	Batteries are assumed to be available to store energy for four, six or eight hours. It is also assumed that there are no limitations on the supply chain for batteries and that they can be interconnected in a timely manner and without cost constraints. To ensure safe operation of batteries and account for degradation throughout the life of the assets, there is an assumed overbuild of batteries to provide the proper safety margin in the depth of discharge; this overbuild was incorporated in the analysis but was not reflected in the "technology prices" section above for purposes of comparability with publicly available information. Seasonal battery storage and associated cost information is not currently available and its development is uncertain, so it is not assumed in the model. We view ongoing research into battery storage as vital to reducing costs and enabling longer-duration storage, but because the timing of technological breakthroughs for battery storage remains unclear (as do the costs of battery storage after the breakthroughs), we did not speculate on the timing or cost impact of a breakthrough in battery technology in this limited analysis.
Technology Innovation	ZELFRs are assumed to be commercially available for deployment in the mid-2030s. ZELFR is a generic placeholder in this modeling effort for a gap in commercially available utility-scale technology to complement very high penetration of renewables. ZELFRs must be flexible to respond to dynamic changes in both load and renewable generation, and must also be capable of sustained generation over long durations to handle severe weather events like "polar vortex" cold events and long-duration generation outages such as those that can occur after hurricanes. For purposes of cost analysis, costs for ZELFRs were based on small modular nuclear reactors as the most feasible option given that 2027 is the expected commercial operation date for the first NuScale SMR reactor and that we have reasonable confidence in the current cost data. For an operational assessment (not based on cost), we also analyzed a generation mix that assumes ZELFRs are combined-cycle power plants that use natural gas, hydrogen or biofuels (such as renewable natural gas), with CCUS as appropriate. In reality, a combination of several technologies will likely be utilized.

Net-Zero Scenario Analysis Results

As discussed above, this analysis was conducted using the same industry-standard expansion planning and hourly production cost modeling tools that we use for integrated resource planning, and assumes normal weather. **It is important to note that the following results are solely illustrative and reflect only one of the possible generation mixes that would result in net-zero emissions by 2050.** We have projected ZELFRs in two ways: (1) with ZELFRs being relatively less-flexible resources, such as a small modular nuclear reactor (SMR), and (2) with ZELFRs being flexible and easily dispatchable (like a NGCC with CCUS). This analysis assumes ZELFRs are half SMRs and half NGCC with CCUS. (It should be noted that NGCC with CCS could also be biofuels or hydrogen.)

These results do not represent definitive utility resource plans. Each utility's resource plan will be developed in conjunction with regulators, policymakers and stakeholders, and will require regulatory approval under our legal mandate to provide affordable and reliable energy.

The following charts show the company's 2019 actual regulated electric utility capacity mix and potential 2030, 2040 and 2050 capacity mixes (in GW) under a net-zero carbon scenario analysis.

Duke Energy Regulated Generating Capacity, GW

2019

42% Gas (25 GW)
27% Coal (16 GW)
15% Existing Nuclear (9 GW)
8% Renewables* (5 GW)
5% Purchase/Sales (3 GW)
3% Storage (2 GW)

2030

49% Gas (36 GW)
20% Renewables* (15 GW)
12% Existing Nuclear (9 GW)
12% Coal (9 GW)
6% Storage (4 GW)
1% Purchase/Sales (1 GW)

2040

39% Gas (34 GW)
35% Renewables* (31 GW)
10% Existing Nuclear (9 GW)
8% Storage (7 GW)
7% ZELFRs (6 GW)
1% Coal (1 GW)

2050

44% Renewables* (47 GW)
23% Gas (24 GW)
12% Storage (13 GW)
12% ZELFRs (13 GW)
9% Existing Nuclear (9 GW)

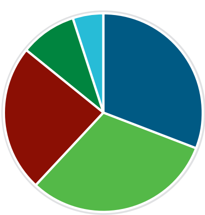
*Renewables include hydro, wind, solar, landfill gas, biomass, etc.

The following charts show the company's 2019 actual regulated electric utility generation (energy) mix and potential 2030, 2040 and 2050 generation mixes (megawatt-hours) under a net-zero carbon scenario analysis.

Duke Energy Regulated Generation, MWh

2019

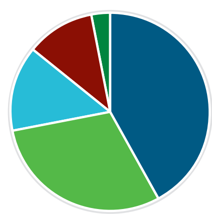
39% CO_2 Reduction



31% Gas
31% Existing Nuclear
24% Coal
9% Purchase/Sales
5% Renewables*

2030

52% CO_2 Reduction



42% Gas
30% Existing Nuclear
14% Renewables*
11% Coal
3% Purchase/Sales

2040

78% CO_2 Reduction

29% Renewables*
29% Existing Nuclear
25% Gas
16% ZELFRs
1% Coal

2050

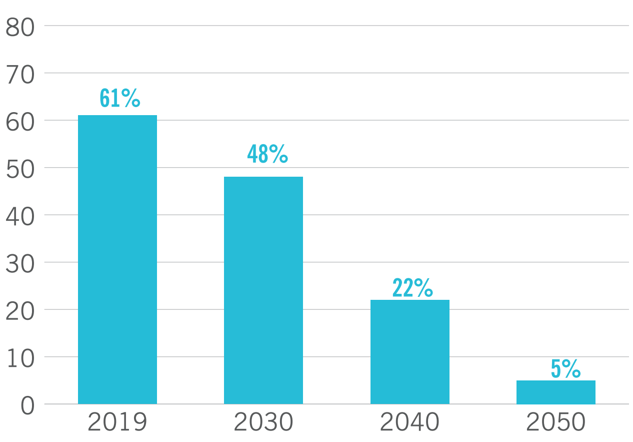
95% CO_2 Reduction

36% Renewables*
30% ZELFRs
28% Existing Nuclear
6% Gas

*Renewables include hydro, wind, solar, landfill gas, biomass, etc.

The following chart shows a projection of how Duke Energy's CO_2 emissions will decline as our electric generating fleet transforms.

Percent of 2005 CO_2 Emissions



Key Insights

We are on track to achieve our 2030 goal of reducing CO_2 emissions from electricity generation by at least 50 percent from the 2005 baseline. The trajectory to make very deep reductions in CO_2 emissions by 2050 in line with our net-zero goal will depend on the availability of advanced low- and no-carbon technologies. Some emissions may be more cost-effectively addressed through the purchase of offsets; we project that would be about 8 million tons in 2050 (approximately 5 percent of our 2005 emissions).[20] Other key insights from the extensive modeling that was conducted to analyze this scenario include:

- **Renewables must be diversified and balanced with energy storage.** Renewables will play a key role in meeting the need for carbon-free energy. Diversity of renewables helps to reduce the need for storage, but even with a balanced portfolio of wind, solar and energy storage, further additions of renewables above a certain point – which varies among each of our modeled jurisdictions – have diminishing value and ultimately become uneconomic for carbon reduction. For example, for solar, this is due to the inability to shift the timing of renewable generation (which peaks midday) to match early- and late-hour peak energy demand. See page 29 for external studies that have reached a similar conclusion, including a study of the impacts of integrating increasing amounts of renewables into Duke Energy's Carolinas territories performed by the National Renewable Energy Laboratory.
- **Maintaining existing nuclear is critical.** Achieving net-zero CO_2 emissions by 2050 requires our existing nuclear fleet to be granted subsequent license renewals. The first Duke Energy nuclear power plants will approach the end of their current operating licenses in the early 2030s.

[20] Carbon offsets are the reduction of greenhouse gas emissions to the atmosphere. These can include modified agricultural practices, tree planting and reductions in other sectors. The market for carbon offsets decades in the future is very uncertain, but given its likely importance for the power sector and other large energy producers/users, we hope and believe that a robust market will emerge. We are monitoring negotiations under Article 6 of the Paris Agreement, where rules for carbon trading and the use of offsets will be developed.

- **ZELFRs will need to be installed by 2035.** In order to achieve our net-zero goal, ZELFRs are needed starting in 2035 to retire older fossil generation, maintain grid reliability and balance the intermittency of renewables.[21] These technologies need to be developed and refined over the next 10 years so that we can confidently plan to use these to serve our customers reliably while achieving net-zero carbon emissions. In the net-zero carbon scenario, ZELFRs make up 12 percent of capacity and supply 30 percent of energy due to their ability to operate at full output over extended periods regardless of weather conditions. The need for dispatchable net-zero carbon resources is driven by the fact that renewable resources are not well-correlated with the winter load shape that drives resource planning requirements for much of the Duke Energy fleet; in addition, the current cost and scale of energy storage technology makes backing up very large amounts of renewables with storage over long durations impractical. If ZELFRs become available and economically feasible prior to 2035, this would provide opportunities to accelerate coal retirements and achieve additional carbon reductions at a relatively low cost.

- **Unprecedented, sustained pace of capacity additions will be needed.** The net-zero carbon scenario requires Duke Energy to add new capacity at a rate double that achieved nationwide during the highest-growth decade in U.S. history, and more than double the rate at which Duke Energy added capacity over the past three decades. Moderate load growth combined with coal and gas retirements, along with the intermittency of renewables and the need for storage capacity, are key drivers for these unprecedented capacity additions. Replacing traditional electric generating capacity with renewables plus storage is not a one-for-one proposition. Due to the intermittency of renewables, significantly more capacity must be built, even with storage availability, to provide the same level of reliable electricity as a fossil plant.[22] This build rate will be challenging from many aspects, including permitting and regulatory approvals, labor, supply chain and interconnection needs.

- **Benefits of natural gas to facilitate the retirement of coal and balance renewables.** Natural gas continues to play a critical role in achieving our 2030 and 2050 carbon reduction goals. Deploying low-cost natural gas helps speed the transition from coal and balance the intermittent nature of renewables. Even in 2050, natural gas capacity needs to remain on the system to maintain reliability, especially during times of peak electricity demand. However, the mission of the gas fleet will change from supplying 24/7 power today to a peaking and demand-balancing function by 2050. This remaining gas generation is projected to represent 5 percent of 2005 emissions, netted to zero through carbon offset purchases.

We conducted a sensitivity analysis that assumed our regulated electric utilities are not allowed to build any additional natural gas generation. This constraint would make maintaining reliable and affordable electricity very challenging, while providing a modest 5 percent decrease in cumulative CO_2 emissions between 2020 and 2050.

This “no new gas” sensitivity presents significant challenges, some of which may be very difficult to overcome, including interconnection and operational and supply chain issues associated with unprecedented additions of energy storage over a very short period of time, as well as regulatory approvals, permitting, construction and greater costs to customers. For example, Duke Energy alone would need to add more than 15,000 MW of energy storage by 2030, more than 17 times the entire battery storage capacity (899 MW) of the entire United States today.[23] Our analysis shows that the incremental cost would be three to four times that of the net-zero scenario that includes gas, and would require the construction and operation of enormous amounts of renewables and energy storage. And this analysis

[21] This capacity is especially important in our Midwest and Florida jurisdictions as they do not currently have nuclear capacity.

[22] See, for example, University of North Carolina: “Measuring Renewable Energy as Baseload Power,” March 2018. https://kenaninstitute.unc.edu/publication/measuring-renewable-energy-as-baseload-power/. To equal 1 MW of natural gas combined-cycle generation, the company would need to add 5 MW of solar with 4 MW of four-hour lithium-ion batteries. The true costs of renewables are therefore substantially higher than the levelized cost of electricity reported in many studies that do not include the cost of backup power.

[23] EIA, U.S. Utility-scale battery storage power capacity to grow substantially by 2023, July 2019. https://www.eia.gov/todayinenergy/detail.php?id=40072.

does not include the substantial transmission and distribution upgrade costs and permitting challenges necessary to enable the increased interconnection of energy storage and renewables. Aside from the implications of the cost impacts to our customers, especially low-income customers and energy-intensive businesses, the dependence of the "no new gas" sensitivity on a rapid addition of energy storage increases the possibility that existing resources would need to be relied upon for a longer time frame than anticipated.

Before considering the "no new gas" sensitivity as a serious alternative, it would be necessary to perform more extensive analysis to address the fact that production cost models have "perfect foresight" (with respect to weather, unplanned generation outages, etc.), while in the real world, operators do not know when such changes will occur and may not have the energy storage in the needed state (of charge or discharge) to manage actual conditions. Based on our historical experience with pumped-hydro energy storage, we understand that relying more heavily on renewables and limited-duration energy storage for capacity (the role dispatchable resources have traditionally played) will increase the complexity of planning and operating the system. Further, highly technical analysis is needed to ensure that the "perfect foresight" assumption is not masking potential system reliability challenges that would need to be addressed.

- **Focused efforts will be required to improve forecasting and portfolio balancing capabilities.** The challenges of balancing load with increasing levels of renewable generation will warrant exploration of opportunities to reduce renewable forecast error and improve our ability to react. Improving the accuracy of renewable generation forecasts will reduce the need for backup requirements (either storage or quickly ramping natural gas). Opportunities to improve forecast accuracy could include advanced sensing/monitoring equipment as well as continued advancements in wind and irradiation forecasting techniques. In order to react more quickly, we are focused on improving the flexibility of our generation fleet, which can be achieved by installing more flexible and dispatchable resources; we are also reviewing potential market opportunities to better enable our grid to accommodate more intermittent, carbon-free resources. We are also exploring opportunities to add flexibility on the demand side through innovative customer programs and rate design.

Third-Party Renewables Studies

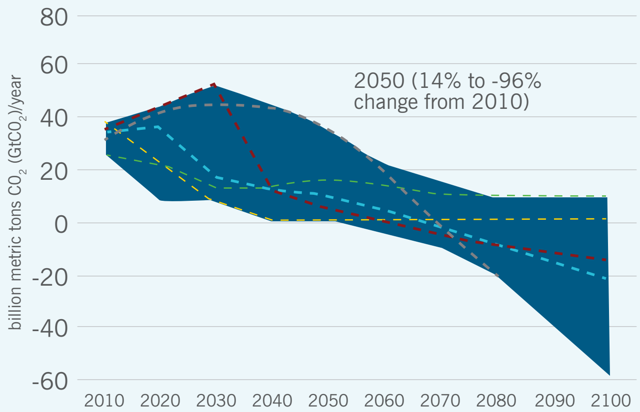
Several recent studies have examined the potential penetration of renewables in the power system. These studies, including one performed by DOE's National Renewable Energy Laboratory (NREL) of Duke Energy's Carolinas system, all conclude that further additions of renewables above 40%-50% of energy served have diminishing value and become increasingly uneconomic for carbon reduction. The studies also find that diversity of renewable resources (wind and solar) enables larger shares of carbon-free generation. Several of these studies are listed below.

- MIT: "Deep Decarbonization of the U.S. Electricity Sector: Is there a Role for Nuclear Power?" September 2019. https://globalchange.mit.edu/publication/17323
- NREL: "Duke Energy Carolinas and Progress: Zero-Emission Resource Integration Study," December 2019. www.nrel.gov/docs/fy20osti/74337.pdf
- MIT: "Storage Requirements and Costs of Shaping Renewable Energy Toward Grid Decarbonization," Joule, November 2019. https://www.sciencedirect.com/science/article/abs/pii/S2542435119303009.

Duke Energy Carbon Reduction Goals and 1.5 and 2 Degree Celsius Global Emissions Scenarios

Many stakeholders are interested in companies' analyses of scenarios that will limit global average warming to 2 degrees Celsius or lower. To inform our view of scenarios and how these relate to our climate goals, Duke Energy has been engaged for nearly two years with the Electric Power Research Institute (EPRI) in a project evaluating scientific understanding of the relationship between company scenarios and global climate goals. The purpose of the project is to develop a strong technical foundation for company analysis and decision-making on scenarios and climate goals. Among other things, the project has assessed the relevant science through a number of studies and derived insights for companies and stakeholders.[24] We find, upon a review of EPRI's conclusions, that the scenario we analyze in this report to achieve our net-zero climate goal is consistent with scenarios limiting global average temperature increase to less than 2 degrees Celsius, and is also consistent with scenarios that limit global average temperature increase to less than 1.5 degrees Celsius.

The EPRI studies find, among other things, that there are many emissions pathways consistent with limiting warming to any particular global average temperature due to uncertainty about future economic conditions, technology advances, energy consumption, other emissions and elements that affect climate change, physical system dynamics, and policy action. For example, the figure above (figure ES-2 from EPRI's 2018 study) shows the range for 408 global emissions pathways derived from peer-reviewed literature that are consistent with limiting warming to less than 2 degrees Celsius.



Global net CO_2 emissions pathway range for pathways consistent with limiting global average temperature to less than 2C. Range for 408 scenarios (shaded area) and illustrative select scenarios (dotted lines) shown. Source: Rose and Scott (2018)

Similar to global economy-wide emissions outcomes, EPRI also concludes that "large ranges of global electricity carbon dioxide (CO_2) emissions pathways and budgets are consistent with limiting warming to 2°C." In addition, the EPRI studies find that the global and sectoral results provide only partial representations of uncertainty, with key uncertainties relevant to individual companies absent (e.g., uncertainty about policy design details and company-specific circumstances).

Importantly, the EPRI study goes on to compare this literature-derived range of pathways with single pathways used by the Science-Based Targets initiative (SBTi) and the United Nations Environment Programme's Finance Initiative.[25] The study concludes that while these single pathways lie within the ranges of the pathways described above, they do not capture the "uncertainty evident in the literature regarding global emissions pathways consistent with limiting warming to 2°C." The factors behind the different pathways are uncertainties relevant to companies and important to consider, in addition to the uncertainties absent (e.g., alternative policy designs).

[24] Rose, S.K., M. Scott, 2018. Grounding Decisions: *A Scientific Foundation for Companies Considering Global Climate Scenarios and Greenhouse Gas Goals*. EPRI. Palo Alto, CA. 3002014510; Rose, S.K., M. Scott, 2020. *Review of 1.5˚C and Other Newer Global Emissions Scenarios: Insights for Company and Financial Climate Low-Carbon Transition Risk Assessment and Greenhouse Gas Goal Setting*, EPRI, Palo Alto, CA. 3002018053.
[25] *Ibid* 2018, Appendix A.

Given that Duke Energy's net-zero by 2050 target is within the range of the scenarios shown in the EPRI analyses, the company believes that the scenario analyzed is consistent with limiting global warming to 2 degrees Celsius. Further, we believe the target is also consistent with limiting warming to 1.5 degrees Celsius according to EPRI's 2020 study. Note, however, that the EPRI analyses find that global scenarios have limited value as benchmarks for assessing company strategies for a variety of reasons, including that the aggregate scenarios do not represent the unique circumstances, uncertainties and risks relevant to individual companies. Furthermore, given that future markets, technology and policy are uncertain, as noted in the net-zero scenario analysis above, exactly how we will achieve our net-zero goal is uncertain; the analysis shown in this report is illustrative of pathways we might take.

Looking Ahead

The actual pathway that Duke Energy takes to achieve net-zero carbon emissions by 2050 will be based on evolving technologies, costs, demand for electricity, public policy, stakeholder input and regulatory approvals. During the 2020s, significant innovation and technological advancement will be critical to ensure we have the viable technology options needed by the 2030s to achieve a net-zero carbon future by the 2050s. As we have done for more than a century, we will collaborate with regulators, policymakers and other stakeholders to evaluate the best options to meet the needs of our customers, while balancing affordability, reliability and sustainability.

Cautionary Statement Regarding Forward-looking Information

This document includes forward-looking statements within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. Forward-looking statements are based on management's beliefs and assumptions and can often be identified by terms and phrases that include "anticipate," "believe," "intend," "estimate," "expect," "continue," "should," "could," "may," "plan," "project," "predict," "will," "potential," "forecast," "target," "guidance," "outlook" or other similar terminology. Various factors may cause actual results to be materially different than the suggested outcomes within forward-looking statements; accordingly, there is no assurance that such results will be realized. These factors include but are not limited to:

- State, federal and foreign legislative and regulatory initiatives, including costs of compliance with existing and future environmental requirements, including those related to climate change, as well as rulings that affect cost and investment recovery or have an impact on rate structures or market prices;
- The extent and timing of costs and liabilities to comply with federal and state laws, regulations and legal requirements related to coal ash remediation, including amounts for required closure of certain ash impoundments, are uncertain and difficult to estimate;
- The ability to recover eligible costs, including amounts associated with coal ash impoundment retirement obligations and costs related to significant weather events, and to earn an adequate return on investment through rate case proceedings and the regulatory process;
- The costs of decommissioning nuclear facilities could prove to be more extensive than amounts estimated and all costs may not be fully recoverable through the regulatory process;

- Costs and effects of legal and administrative proceedings, settlements, investigations and claims;
- Industrial, commercial and residential growth or decline in service territories or customer bases resulting from sustained downturns of the economy and the economic health of our service territories or variations in customer usage patterns, including energy efficiency efforts and use of alternative energy sources, such as self-generation and distributed generation technologies;
- Federal and state regulations, laws and other efforts designed to promote and expand the use of energy efficiency measures and distributed generation technologies, such as private solar and battery storage, in Duke Energy service territories could result in customers leaving the electric distribution system, excess generation resources as well as stranded costs;
- Advancements in technology;
- Additional competition in electric and natural gas markets and continued industry consolidation;
- The influence of weather and other natural phenomena on operations, including the economic, operational and other effects of severe storms, hurricanes, droughts, earthquakes and tornadoes, including extreme weather associated with climate change;
- The impact of the COVID-19 pandemic;
- The ability to successfully operate electric generating facilities and deliver electricity to customers including direct or indirect effects to the company resulting from an incident that affects the United States electric grid or generating resources;
- The ability to obtain the necessary permits and approvals and to complete necessary or desirable pipeline expansion or infrastructure projects in our natural gas business;
- Operational interruptions to our natural gas distribution and transmission activities;
- The availability of adequate interstate pipeline transportation capacity and natural gas supply;
- The impact on facilities and business from a terrorist attack, cybersecurity threats, data security breaches, operational accidents, information technology failures or other catastrophic events, such as fires, explosions, pandemic health events or other similar occurrences;
- The inherent risks associated with the operation of nuclear facilities, including environmental, health, safety, regulatory and financial risks, including the financial stability of third-party service providers;
- The timing and extent of changes in commodity prices and interest rates and the ability to recover such costs through the regulatory process, where appropriate, and their impact on liquidity positions and the value of underlying assets;
- The results of financing efforts, including the ability to obtain financing on favorable terms, which can be affected by various factors, including credit ratings, interest rate fluctuations, compliance with debt covenants and conditions and general market and economic conditions;
- Credit ratings of Duke Energy and its registered subsidiaries may be different from what is expected;
- Declines in the market prices of equity and fixed-income securities and resultant cash funding requirements for defined benefit pension plans, other post-retirement benefit plans and nuclear decommissioning trust funds;
- Construction and development risks associated with the completion of Duke Energy's capital investment projects, including risks related to financing, obtaining and complying with terms of permits, meeting construction budgets and schedules and satisfying operating and environmental performance standards, as well as the ability to recover costs from customers in a timely manner, or at all;
- Changes in rules for regional transmission organizations, including changes in rate designs and new and evolving capacity markets, and risks related to obligations created by the default of other participants;
- The ability to control operation and maintenance costs;

- The level of creditworthiness of counterparties to transactions;
- The ability to obtain adequate insurance at acceptable costs;
- Employee workforce factors, including the potential inability to attract and retain key personnel;
- The ability of subsidiaries to pay dividends or distributions to Duke Energy Corporation holding company (the Parent);
- The performance of projects undertaken by our nonregulated businesses and the success of efforts to invest in and develop new opportunities;
- The effect of accounting pronouncements issued periodically by accounting standard-setting bodies;
- The impact of United States tax legislation to our financial condition, results of operations or cash flows and our credit ratings;
- The impacts from potential impairments of goodwill or equity method investment carrying values; and
- The ability to implement our business strategy, including enhancing existing technology systems.

Additional risks and uncertainties are identified and discussed in Duke Energy's reports filed with the SEC and available at the SEC's website at sec.gov. In light of these risks, uncertainties and assumptions, the events described in the forward-looking statements might not occur or might occur to a different extent or at a different time than described. Forward-looking statements speak only as of the date they are made and Duke Energy expressly disclaims an obligation to publicly update or revise any forward-looking statements, whether as a result of new information, future events or otherwise.

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September 9, 2019

Ms. Sushma Masemore, PE
Deputy Assistant Secretary for Environment
NC Department of Environmental Quality
217 W. Jones Street
Raleigh, NC 27603

Dear Ms. Masemore,

Duke Energy is pleased to submit the enclosed comments to the state's draft Clean Energy Plan (CEP) as the Department of Environmental Quality continues its efforts to gather input and finalize the plan. We appreciate Governor Cooper's leadership in developing sound energy policy for North Carolina. We stand ready to continue participating in broad stakeholder collaboration and offer the expertise we've gained in serving our customers' energy needs reliably and affordably for more than a century.

In our review, we considered these important issues through the lenses of impacts to customers, effectiveness, equality and feasibility and drew on our experience on the front lines 24 hours a day, 7 days a week working to provide electric service for North Carolina's residents, businesses and critical services – including in challenging circumstances such as Hurricanes Florence and Dorian. We share many of the state's objectives in this transition to cleaner energy and have made strong progress in the last decade. We also recognize the need to pursue the regulatory and legislative updates and technology advances we need to continue driving carbon out of the electric system in an equitable way that supports North Carolina's thriving economy.

Thank you for the opportunity to provide this input.

Sincerely,

Mark McIntire

Mark McIntire, PE, BCEE

Duke Energy's Comments on the Draft NC Clean Energy Plan

Executive Summary

Duke Energy appreciates Governor Cooper's leadership to develop sound energy policy for North Carolina and the Department of Environmental Quality's effort to engage stakeholders in the development of this draft Clean Energy Plan (CEP). Many of the elements discussed in the plan align with Duke Energy's business strategy, including reducing carbon emissions, expanding clean energy, modernizing the grid and supporting the growth of electric vehicles. With below-average electricity prices, declining emissions, above-average carbon-free nuclear and installed solar capacity and policies in place to support continued investment in clean energy, the state is well-positioned to meet the expectations of residents and businesses for energy that is reliable, affordable and clean. North Carolina's history of broad stakeholder collaboration on clean energy policies has made the state a national leader, and Duke Energy is proud to be an integral part of helping the state build on the progress made to date and achieve its long-term goals.

Duke Energy respectfully submits the following comments on the draft plan. These comments follow four guiding principles:

1. **Customer centric.** All North Carolina citizens and businesses depend on electricity to power their lives. How does any proposed policy – at the state or federal level – affect the company's customers?

2. **Effectiveness.** What problem is the proposed policy attempting to solve? If implemented, would it be effective?

3. **Equality.** Duke Energy has the legal obligation to serve everyone within its service territory. Is the policy good for everyone or just a few? Does it pick winners and losers?

4. **Feasibility.** The electric system is an incredibly technical and complex machine that requires precision to remain in balance every moment of every day. Constructive energy policy reconciles technically feasible, operationally feasible and economically feasible.

As requested by DEQ, the company's detailed comments are organized along eight themes. A high-level summary of the company's perspective on the draft plan's approach to each of these themes follows:

Greenhouse Gas Emissions and Climate Concerns: Duke Energy is committed to the environment and is doing its part to lower the risk of climate change. Between 2005 and 2018, CO_2 emissions from the company's generation fleet fell by 31 percent enterprise-wide and nearly 35 percent in the Carolinas, outpacing the industry average of 27 percent. Over the next decade, Duke Energy is on track in the Carolinas to reduce carbon emissions by over 50 percent relative to a 2005 baseline. Beyond 2030 even further reductions are attainable with continued technology development in the areas of carbon-free generation and energy storage.

Duke Energy supports a continued dialogue with the state and diverse stakeholders regarding opportunities to further reduce greenhouse gas emissions while keeping energy reliable and affordable. The company believes that, with supportive state policies, emission reductions in the electric sector can be achieved without a price on carbon that significantly increases customer bills.

The company's detailed comments offer several clarifications and key factors that must be considered to ensure reliability and affordability throughout this transition to a cleaner North Carolina energy future. This includes the critical role – today and in the future – of nuclear energy, which contributes about 47 percent of Duke Energy's generation in the Carolinas and more than 80 percent of the company's carbon-free generation in this region.

Utility Tools & Incentives: As described in the draft CEP, "[North Carolina] enjoys some of the lowest retail electricity prices in the nation…." At the same time, North Carolina is ranked second in the nation for installed solar capacity and has outpaced the industry's average CO_2 reduction since 2005. The energy industry is undergoing a massive, top-to-bottom transformation, however. Utilities face increasing needs to modernize their systems to improve resiliency and reliability, keep pace with evolving customer expectations and new technologies, and to transform the electric grid to a two-way system that is more capable of integrating renewable distributed energy resources, well-protected from cyber and physical threats and gives customers more options and control over their energy use.

Duke Energy believes that modern utility rate-making tools, such as multi-year rate plans, are needed expeditiously to support more predictability and bill stability for customers and allow utilities to focus more on efficient operations and the types of innovation that give customers greater value at a faster pace.

Comprehensive Utility System Planning: The landscape of utility planning is evolving due to declining costs for renewables and storage, customer preferences and policy goals. Duke Energy has connected more than 3,000 MW of solar in North Carolina. With HB 589, the company will continue to grow that portfolio, with a target of 7,000 MW coming onto the system by 2025. Duke Energy's utilities in the Carolinas have received over 20,000 solar interconnection requests and have connected nearly 17,000 projects since 2006. North Carolina has more distribution-connected utility scale solar than any other state in the country.

Duke Energy supports a more robust approach to distribution planning, including extensive coordination with (generation) resource planning and transmission planning. For this reason, Duke Energy is already actively working toward more extensive integration of distribution, generation and transmission planning (Integrated System & Operations Planning or "ISOP") with a goal of initial implementation in the 2022 Integrated Resource Plans (IRPs). Duke Energy agrees that engaging stakeholders in the development of ISOP is important. The company also believes that ISOP can work within the existing IRP regulatory framework and that ISOP will achieve the basic goals of Integrated Distribution Planning (IDP) being pursued by other states.

Grid Modernization to Support Clean Energy & Grid Resiliency and Flexibility: Providing safe, reliable, affordable and secure energy to all the company's customers is core to Duke

Energy's mission. The company is making smart, data-driven improvements to increase reliability, strengthen the grid against cyber and physical threats, expand solar and innovative technologies and provide customers with the intelligent information they need to make smart energy choices and save money. These improvements will provide benefits now and for years to come and are informed by seven "megatrends" – six of which can be found in the draft CEP. The company is already implementing several of DEQ's recommendations through the Grid Improvement Plan (GIP). The company's comments in this section offer several clarifications and identify opportunities to build on the important work that is already underway. Duke Energy's GIP will help prepare the state for a distributed energy future, and even incorporate distributed energy resources ahead of the industry in cases where that makes sense.

Customer Access to Clean Energy & DER Interconnection and Compensation: At Duke Energy, the customer is at the center of the company's mission. Evolving customer expectations, emerging technologies and changing public policies all contribute to a dynamic environment for Duke Energy and the industry. Part of the company's work to transform the customer experience includes providing customers more options and control over when and how they use energy. Duke Energy is proud of the new and expanded tools provided to enable customers to access and support renewable energy. This includes programs created by HB 589 – such as solar rebates, shared solar and Green Source Advantage – and more, like the Renewable Advantage REC purchasing program, which is currently pending before the NCUC. Duke Energy's comments in this section clarify several details of the company's existing and pending programs and instances where the company must balance competing priorities throughout this transition while meeting the obligation to provide all customers with reliable and affordable power.

Equitable Access and Energy Affordability & A Just Transition to Clean Energy: As a North Carolina company, Duke Energy understands that electricity is a significant monthly expense for many customers. That's why the company is committed to helping customers who struggle to pay for basic needs with programs and tools to reduce their energy costs and keep their power on. It is also why the company's investments in the community transcend business expenses and include support for programs that build strong and resilient communities. During the last three years, Duke Energy has averaged $22.8 million in annual charitable giving in North Carolina. Additionally, the company's employees and retirees have donated their volunteer time, averaging $6.9 million in annual value.

The draft CEP points to states like California, Hawaii and Rhode Island – places with some of the highest electricity rates in the nation – as models. It will be important to look to these and other states for lessons learned. It will also be important to consider the unique aspects of North Carolina's citizens, economy, climate and resources as opportunities to balance the goals of affordable, reliable and clean are identified. For example, rate increases may be more impactful in North Carolina because residents commonly use electricity for both heating and cooling and average incomes are not as high. Additionally, the lack of correlation between renewables and North Carolina peak load means, especially on winter mornings, that the point of diminishing returns is reached more quickly than states with a higher correlation between renewable output and peak load. This can lead to a greater financial burden for customers if not managed properly. To address these challenges, the proposed “analysis of promising strategies” (page 5) could include a quantified affordability metric, such as a price cap.

The company’s detailed comments on equitable access, energy affordability and a just transition are informed by more than a century of service to North Carolina communities and, again, by the obligation to provide all customers with reliable and affordable power.

Energy Efficiency and Demand Management Duke Energy’s energy efficiency and demand response programs are a win for everyone. The company currently offers energy efficiency programs like Lower My Bill Toolkit, Residential Smart Saver and Neighborhood Energy Saver as well as demand response programs for business and residential customers. Across the Carolinas, more than 400,000 residential customers are actively participating in residential demand side management, allowing Duke Energy to control their air conditioners during peak demand times. These programs provide Duke Energy with an important tool that can be used to reduce energy demand. According to the Southern Alliance for Clean Energy’s *Energy Efficiency in the Southeast 2018 Annual Report*, Duke Energy Carolinas and Duke Energy Progress are the top two utilities in the Southeast for energy efficiency performance. The company’s comments on DEQ’s energy efficiency and demand management proposals are intended to help identify the most promising opportunities to advance these objectives based on extensive experience delivering successful energy efficiency and demand management programs to customers throughout the company’s seven jurisdictions.

Transportation Electrification: Supporting the use of electric transportation is a Duke Energy priority that will benefit communities, customers and the state’s future. Today, transportation contributes over 30 percent of greenhouse gas emissions in North Carolina. Based on DEQ’s GHG Inventory projections, and reflecting current Duke Energy forecasts, the transportation sector will overtake the electric sector as the largest contributor to North Carolina GHG emissions well before 2030 (See: https://files.nc.gov/ncdeq/climate-change/ghg-inventory/GHG-Inventory-Report-FINAL.pdf).

It will be critical to take a comprehensive approach and promote state policies to enhance EV adoption. While managed charging will become increasingly important as EV adoption grows, there is little evidence that EV-specific utility rates drive EV adoption. Therefore, the greatest emphasis should be placed on driving adoption with incentives and utility investment in fast charging infrastructure. As part of a commitment to build a cleaner and smarter North Carolina, Duke Energy is proposing the largest investment in electric vehicle (EV) infrastructure ever in the Southeast – a $76 million initiative to spur EV adoption across the state. The company’s comments focus on opportunities for North Carolina to advance electric transportation, recognizing that EVs are already cleaner than conventional vehicles with the generation mix that exists today.

Greenhouse Gas Emissions and Climate Concerns

Duke Energy is committed to the environment and is doing its part to lower the risk of climate change. Between 2005 and 2018, CO_2 emissions from the company's generation fleet fell by 31 percent enterprise-wide and nearly 35 percent in the Carolinas, outpacing the industry average of 27 percent. Over the next decade, Duke Energy is on track in the Carolinas to reduce carbon emissions by over 50 percent relative to a 2005 baseline level. Beyond 2030 even further reductions are attainable with continued technology development in the areas of carbon free generation and energy storage.

As opportunities to drive emissions out of the electricity system are identified, the U.S. is leading the world in CO_2 emissions reductions. Nearly half of all global reductions from 2007 to 2017 came from the U.S., and the electric sector is responsible for nearly 80 percent of U.S. CO_2 reductions [See: BP Statistical Review of World Energy, 2018, p. 49 (showing U.S. and global CO_2 emissions by country from 2007 – 2017 – U.S. emissions are 45% of all reductions); EIA Monthly Energy Review, May 2019, Tables 12.1 and 12.6 (showing U.S. and electric sector emissions from 1973 – 2018 – electric sector 2007 – 2017 are 78% of all reductions)].

Duke Energy supports a continued dialogue with the state and diverse stakeholders regarding opportunities to further reduce greenhouse gas emissions while keeping energy reliable and affordable and stands ready to assist in determining the right path. The company will evaluate any proposed policy on its merits, including the specific details of the proposal. With supportive state policies, the company believes that emission reductions in the electric sector can be achieved without a price on carbon that significantly increases customer bills. The company also offers that the following key factors should be considered in the further analysis of potential strategies or actions (page 5):

The Critical Role of Carbon-free Nuclear Energy: Today, nuclear is North Carolina's largest source of carbon-free energy (page 33). Nuclear is the only proven dispatchable, zero emitting resource and plays a vital role in lowering North Carolina's and Duke Energy's carbon emissions, contributing 47 percent of the company's total generation in the Carolinas and more than 80 percent of the company's carbon-free generation. In 2018, nuclear enabled the company to avoid the release of about 54 million tons of carbon dioxide (as much carbon dioxide as is released from more than 10 million passenger cars). The modeling scenarios conducted by stakeholders and submitted to DEQ in the CEP stakeholder process assume the continued operation of existing nuclear (including, in some cases, license renewal). Consistent with leading climate studies, these existing emissions-free resources are the cornerstone of any effort to further decarbonize the electricity sector. In addition, these facilities employ more than 5,000 workers in the Carolinas with an average salary of more than $99,000 and paid more than $308 million in property and payroll taxes in 2018. Research by Clemson University, the Carolinas' Nuclear Cluster and E4Carolinas concludes the nuclear industry provides a total economic impact of $20-$25 Billion to the two-state Carolinas region. (See: http://e4carolinas.org/wp-content/uploads/2016/06/NC-SC_NuclearEconImpactReport.pdf).

Maintaining Affordability and Reliability: The draft CEP summarizes the evolving goals that participating stakeholders have for their energy providers, including a high priority on the environment and carbon reduction while continuing to place high value on reliability and affordability. Research demonstrates that Duke Energy customers place the highest priority on reliability and affordability, and they also want more clean energy, a more secure grid and greater resiliency. Analyses of potential strategies or actions should place an emphasis on balancing evolving and longstanding priorities, including in consideration of the ideal timeline, policy design and target levels (recommendation I-2).

Maintaining affordability and reliability requires affordable resources capable of increasing and decreasing output on demand to complement variable output from solar and wind. As renewables continue to grow, the incremental energy and capacity value of these resources decreases due to extended periods of excess energy in the spring and fall (when demand is low) and insufficient output during dark winter mornings (when demand is high). While energy storage helps to mitigate short periods of excess and lower output, storage alone cannot address the capacity and energy deficiency during the winter months.

It is important to recognize that current battery storage technology represents both opportunities and challenges. Battery storage technology can quickly charge or discharge energy on demand. In addition to providing broader reliability and system benefits, the battery can help deliver energy during peak demand hours. However, batteries can only store a limited amount of energy, making battery storage a finite resource. The current dominant battery storage technology is lithium ion. Typical lithium ion battery projects have at most a 4-hour duration. While 4-hour batteries can effectively serve a portion of peak demand, eventually a longer duration solution will be required to maintain adequate system capacity. For this reason, Duke Energy is a strong advocate for research and development.

Role of Natural Gas: Natural gas also has a critical role to play in this transition. U.S. emission reductions to date have primarily been achieved through the replacement of coal with natural gas and a growing amount of renewables. The United Nations' Intergovernmental Panel on Climate Change (IPCC) stated in its 2014 summary report:

"GHG emissions from energy supply can be reduced significantly by replacing current world average coal-fired power plants with modern, highly efficient natural gas combined-cycle power plants or combined heat and power plants … natural gas power generation without CCS acts as a bridge technology, with deployment increasing before peaking and falling to below current levels by 2050 and declining further in the second half of the century" (See: United Nations Intergovernmental Panel on Climate Change, Climate Change 2014: Mitigation of Climate Change, Summary for Policymakers, at 21).

Natural gas' ability to generate electricity 24/7 enables coal retirements, and both supplements and supports the addition of more renewable resources. To ensure North Carolina can reliably meet customer demand for electricity, there must be a complementary power source that can ramp up and down in response to demand and renewables' variability, regardless of the weather. Natural gas-fueled generation is ideally suited to meet this need. It is a flexible, dependable, inexpensive and low carbon resource (with less than half the CO_2 emissions of coal). Ensuring North Carolina has a resilient supply of energy – including affordable natural gas

– will be critical to enable timely retirement of coal units while maintaining a reliable and affordable electric system for customers.

Continued Stakeholder Involvement: The draft CEP recommends that DEQ, in partnership with academics, conduct a study of most cost-effective options to achieve a carbon target for the electricity sector, including clean energy driven and carbon policy scenarios (page 113). Any study should also determine the reliability implications of the pathways studied and provide opportunities for continued stakeholder involvement. Duke Energy recently evaluated one possible pathway consistent with a "two-degree policy" in the company's 2017 Climate Report to Shareholders. The company has over a century of experience building, operating and maintaining North Carolina's energy system and stands ready to support DEQ in its analysis. An important first step is to develop a shared understanding of baseline carbon emissions.

Additionally, Duke Energy offers the following specific or clarifying comments on this section of the draft:

- Page 33: "Traditional fuel resources such as coal, natural gas and nuclear…." Nuclear should be listed separately. Nuclear stands apart as the only proven dispatchable, zero carbon resource.
- Page 37: The discussion of drivers of decarbonization should include the role that inexpensive natural gas has played in enabling coal retirements (See: https://www.eia.gov/todayinenergy/detail.php?id=39012).
- Page 53: "…consisted of large central fossil fuel plants." Add "and nuclear."
- Pages 108 and 112: Define "uneconomical" fossil generation and peaking plants. For example, under what scenarios (e.g. carbon or natural gas prices) or on what timeline?
- Page 109: In Table 4 ("Accelerate Fossil Retirement"), the company recommends inserting "...or shift to gas use..." after "all coal plants retire by 2030." Additional questions to consider include: How would net book value recovery be addressed? Should there be an offramp with price caps or rate increase limits for customers over a certain timeframe? How would DEQ propose to replace all coal generation (> 9,000 MWs excluding Cliffside 6, which is 100 percent gas capable) with non-emitting resources? How would the winter morning peak be handled by non-emitting sources? Here, it is important to remember that – in contrast to the estimate on page 21 of the Emissions & Modeling Supporting Document – 1 MW of solar does not equal 1 MW of traditional generation. A recent study by the Kenan Institute at UNC demonstrates it takes 2,958 MW of solar connected to 10,250 MWH of battery storage to replace a single 650-MW natural gas combined-cycle plant. (See: https://www.kenaninstitute.unc.edu/wp-content/uploads/2018/05/Kenan-Institute-Report-Measuring-Renewable-Energy-as-Baseload-Power-v2.pdf).
- Page 111: The third paragraph states that North Carolina's generation from "clean energy resources" in 2017 was 9 percent. This paragraph should also note the amount of generation from zero-emissions nuclear energy (more than 30 percent).

- Page 112: With respect to new fossil fuel infrastructure, DEQ should consider CCS-ready gas, including a feasibility analysis of CO_2 pipelines.

- Page 113: The comprehensive study should include the feasibility and cost of the various options, as well as reliability impacts (in addition to CO_2 reduction projections). Renewable portfolio standards are typically a much more expensive means to achieve the same carbon reductions relative to cap and trade programs. In the study, the mass cap option should include the option of acquiring offsets if the desired 2030 reductions cannot be met reliably and economically.
- Pages 113 and 115: It is not clear between page 113 and page 115 whether the “comprehensive study” will focus on the full range of 60-70 percent reductions (page 113) or only 70 percent (page 115). Duke Energy recommends the study examine the full range.
- Page 114: In recommendation I-3, it is not appropriate to consider carbon emissions associated with pipelines in this scenario for the same reasons that FERC and the recent EPA NEPA draft guidance advise that consideration should not be given where the impact is remote or speculative [“agencies preparing NEPA analyses need not give greater consideration to potential effects from GHG emissions than to other potential effects on the human environment” and “a ‘but for’ causal relationship is not sufficient” (see the June 21, 2019 CEQ-NEPA Draft GHG Guidance)]. The ACP is not for the sole purpose of power generation. However, if carbon emissions associated with natural gas pipelines are to be “counted,” they should be weighed against the carbon emissions that will be reduced when the pipeline enables the retirement of coal.
- Page 115: For recommendation I-3, legislative action would be needed to set a cost of carbon. The cost of carbon also needs to be fully vetted and debated. Academics, regulators and industry will all have opinions. Keeping electricity rates affordable should be a major consideration. Finally, this recommendation should apply to all North Carolina utilities.
- Global Observation: The recently promulgated federal Affordable Clean Energy (ACE) rule requires investments in heat rate improvements at coal plants. Any policy intended to accelerate coal retirements should either (1) provide for the recovery of those costs or (2) enhance the state's ability to avoid new investments - and therefore reduce customer impacts - at coal plants that will soon retire. The latter can be achieved through the State Implementation Plan (SIP) required by ACE. Similarly, Duke Energy is currently completing the study phase of federal Clean Water Act 316(b) rule and preparing to install capital compliance projects. Those compliance projects should also be evaluated considering the potential for earlier retirements.

Utility Tools & Incentives

The current regulatory model in North Carolina has served utilities and their customers well for more than a century. As the draft CEP notes, "Our state enjoys some of the lowest retail electricity prices in the nation, with a ranking in the bottom 10 states for the past several years. North Carolina's average residential rate has been about 6 percent less than the South Atlantic region and about 11 percent less than the nation since 2015" (page 35). At the same time, North Carolina is ranked second in the nation for installed solar capacity and Duke Energy has reduced carbon emissions from generation in the Carolinas by about 35 percent between 2005 and 2018, beating the U.S. average of 27 percent. The state enjoys low rates, high reliability and confident responses to extreme heat, cold and storms.

The energy industry is undergoing a massive, top-to-bottom transformation, however, which means the way energy providers do business is changing. Utilities face increasing needs to modernize their systems to improve reliability, keep pace with evolving customer expectations and new technologies, and to transform the electric grid to a two-way system that is well-protected from cyber and physical threats, integrates more renewables and distributed energy sources and gives customers more options and control over their energy use.

With respect to recommendations A-1 and A2, Duke Energy agrees that alternative utility rate-making mechanisms are needed expeditiously to provide more predictability and bill stability for customers and allow utilities to focus more on efficient operations and the types of innovation that give customers greater value at a faster pace. Across the country, states are implementing modern rules to benefit customers and transform the grid. While every state and utility is unique, these modern rules better align recovery of utility costs to serve customers with investment in the innovative products and services that customers want and need to run their lives. Multiyear rate plans and grid recovery mechanisms are just two examples that many states have adopted as part of a forward-looking energy regulatory framework. The company looks forward to continued dialogue with the state and stakeholders about the best tools to deliver that value.

Recommendation A-3 of this section comprises a "study on the potential costs and benefits of different options to increase competition in electricity generation, including but not limited to joining an existing wholesale market and allowing retail energy choice." Duke Energy believes any study of this nature should:

- Be led by a neutral agent;
- Create common definitions and understanding around terminology of options, such as RTO, market and retail choice;
- Evaluate potential benefits, costs, risks, regulatory requirements, dependencies (e.g., combined utility systems in North Carolina and South Carolina), and the ability to meet the objectives of this CEP;
- Be clear about what decisions shift control and jurisdiction from the state to the federal government with respect to rules, oversight and processes/procedures (e.g., interconnection);
- Consider the impact of options across stakeholder groups, including customer classes (e.g., potential cost shifts);

- As a scoping input to the study, consider what control the states want to maintain, particularly as it relates to coordinated planning of generation, transmission and pricing; and
- As a scoping input to the study, consider what the study evaluations and assumptions should be for supply adequacy, capacity and reliability.

Finally, while the draft CEP calls for a study of both “costs” and “benefits,” this section as written is heavily focused on potential benefits. The final plan should explicitly acknowledge potential outcomes that conflict with the goals of the CEP and should be examined in any study. For example:

- Advancing a Cleaner Grid: Wholesale markets are not guaranteed to advance a cleaner grid; they are – at least today – price-driven and not carbon-driven.
- Driving Down Prices: Markets can go up or down, depending on dynamics, and customers are subject to those swings.
- Reliability: North Carolina and South Carolina currently benefit from excellent reliability and high-quality storm responses under increasingly challenging circumstances. The region is large with a diverse generation mix and a long track record of reliability performance, so "increased" reliability would not be an expected outcome of competition.
- Equity and Affordability: In states that require retail competition, residential and small commercial customers have sometimes suffered. For example, an investigation in Massachusetts found that consumers overpaid by nearly $180 million and that low-income consumers were disproportionately affected. As a result, the Massachusetts Attorney General is calling for an end to the competitive retail market for residential customers (See: https://www.mass.gov/competitive-electric-supply).

Comprehensive Utility System Planning

Duke Energy agrees that the landscape of utility planning is evolving due to declining costs for renewables and storage, customer preferences and policy goals. The company has connected 3,000 MW of solar in North Carolina, and with House Bill 589, will achieve 7,000 MW by 2025. Duke Energy's utilities in the Carolinas have received over 20,000 solar interconnection requests and connected nearly 17,000 projects since 2006. North Carolina has more distribution-connected utility scale solar than any other state.

A more robust approach to distribution planning is necessary, as well as extensive coordination with (generation) resource planning and transmission planning. For this reason, Duke Energy is actively working toward more extensive integration of distribution, generation and transmission planning (Integrated System & Operations Planning or "ISOP") with a goal of implementation in 2022 IRPs. Duke's ISOP development team has gathered input from other utilities, national labs, EPRI, consultants and academic groups to inform the company's vision and work-scope and has been working on extending modeling capabilities to better address renewables and energy storage for the last few years.

Duke Energy also agrees that it is important to get input from customers and other stakeholders to enhance and further integrate planning processes. The company is working toward a stakeholder process for ISOP and has begun outreach efforts to gather input from stakeholders on the approach. In addition, Duke Energy has been reaching out to other utilities with stakeholder engagement processes (Hawaii Electric Companies, TVA, Xcel, NV Energy etc.) to learn from their experience.

The ISOP engagement contemplated thus far is focused on gathering input and sharing information about the new ISOP processes, which target integration of capacity and energy resources such as distributed energy resources and customer programs across generation, transmission and distribution planning disciplines. Duke Energy has not yet evaluated the implications of transitioning the ongoing planning processes to a full or partial collaborative stakeholder process, and thus is not prepared to take a position in favor or against this recommendation. However, several factors should be considered in any stakeholder process for system planning:

- DEC and DEP Balancing Areas include both North Carolina and South Carolina resources and load obligations, and both states have benefitted from the economies of scale in a combined planning process. Any ISOP-related stakeholder engagement process should include both North and South Carolina stakeholder representatives to ensure balanced outcomes for customers in both states.

- Utilities hold a unique role as the only stakeholders with a regulatory obligation to serve under North Carolina, South Carolina and FERC/NERC oversight. These oversight processes ensure a focus on safe, reliable and affordable service and motivate utilities to maintain a balanced perspective to meet changing customer expectations, including environmental considerations. Other stakeholders may focus on a single objective. Utilities are inherently technology agnostic, but the "obligation to serve" does drive a high priority on reliability and flexibility of resources. Many other stakeholders do not have this responsibility, and therefore may not place similar value on reliability and flexibility of resources.

Recommendation B1 proposes a "comprehensive system planning process with meaningful stakeholder participation, starting with integrated distribution planning (IDP)…." As described on page 67, Duke Energy is already working towards ISOP. The company believes that ISOP can work within the existing IRP regulatory framework and that ISOP will achieve the basic goals of IDP being pursued by other states.

In addition to these overarching comments on recommendation B-1, the company offers the following clarifying comments on this section of the draft CEP:

- Page 11: In the first paragraph, "delivering thousands of MW" should be "satisfying a peak winter demand of over 36,000 MW."
- Page 11: The second paragraph broadly describes recent trends in electricity demand growth as relatively flat. This discussion should distinguish between energy and capacity. It should also recognize forecasted growth rates. The growth rate forecasts in Duke Energy's 2019 IRPs, including impacts of new energy efficiency programs, are as follows: Duke Energy Progress Summer Peak – 1%, Winter Peak 0.9% and Energy – 1%; Duke Energy Carolinas Summer Peak – 1%, Winter Peak 0.8% and Energy 0.9% (See: https://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=7f4b3176-95d8-425d-a36b-390e1e57a175; https://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=40bbb323-936d-4f06-b0ba-7b7683a136de.)
- Page 12: Add the statement, "While 1 MW of solar does not equal 1 MW of traditional generation, a more detailed analysis of opportunities for coal retirements in North Carolina may identify opportunities to accelerate the transition to clean energy" before "Nearby…." This is important because the report cited in the draft CEP states, "for simplicity, the modeling compares each coal plant's marginal cost of energy (MCOE) to the lowest levelized cost of energy (LCOE) for wind or solar resource localized around that coal plant" (Energy Innovation and Vibrant Clean Energy page 2). However, 1 MW of solar does not equal 1 MW of traditional generation. A recent study by the Kenan Institute at UNC demonstrates it takes 2,958 MW of solar connected to 10,250 MWH of battery storage to replace a single 650-MW natural gas combined-cycle plant. (See: https://www.kenaninstitute.unc.edu/wp-content/uploads/2018/05/Kenan-Institute-Report-Measuring-Renewable-Energy-as-Baseload-Power-v2.pdf).
- Page 12: "The opportunity to save money is available" is an unsupported statement.
- Page 28: For recommendation J-2, consider how this coordinated planning will intersect with federal jurisdiction (e.g. over cybersecurity). Add "physical" security.
- Page 54: "Stakeholders conveyed that a new regulatory framework…[can] avoid system costs...." While it may be true that some costs can be avoided, additional costs may also be created.
- Page 60: "Forcing reconsideration of utility's longstanding responsibilities." While Duke Energy agrees that utilities are being asked to meet new and evolving goals, moving ahead, many (if not all) of the long-standing responsibilities in the regulatory compact

(e.g., the obligation to serve, providing reliable and affordable energy) must continue to be provided by some mechanism.

- Page 63: The table should generically name all utilities as responsible entities, consistent with other parts of the document.
- Page 69: Recommendation B-1 suggests that IDP should include identification of "locational value" of DERs. Any analysis of locational value should include (1) both benefits and the costs of the resource, where they exist and (2) the impact of DERs on the Bulk Electric System (BES), including alignment with any NERC reliability requirements.
- Page 71: Recommendation B-2 implies that least cost planning may be an impediment to clean energy planning. However, least cost planning is not in conflict with environmental goals when clear environmental policy is established through lawmaking and/or regulatory processes. Successful examples include the Clean Smokestacks Act and federal programs for NO_x and SO_2. Duke Energy supports collaboratively informed processes to establish environmental policies that provide clarity for planning.
- Page 71: "For resources to be more accurately accounted for in utility planning regulators should consider…." Also add security (physical and cyber).

Grid Modernization to Support Clean Energy & Grid Resiliency and Flexibility

Providing safe, reliable, affordable and secure energy to all the company's customers is core to Duke Energy's mission. The company is making smart, data-driven investments to increase reliability, strengthen the grid against cyber and physical threats, expand solar and innovative technologies and provide customers with the intelligent information they need to make smart energy choices and save money. These investments will provide benefits now and in the years to come and are informed by seven "megatrends" – six of which can be found in the draft CEP, including: (1) threats to grid infrastructure, (2) technology advancements in renewables and distributed energy resources, (3) lower carbon future and other environmental trends, (4) impact of weather events, (5) grid improvement and (6) customer expectations (see pages 10-12, 41, 48-49, 116-120, 125, and 129). In addition, Duke Energy has been tracking a megatrend of concentrated population growth in urban areas, which has significant implications for equity.

Duke Energy is already implementing several of DEQ's recommendations through the Grid Improvement Plan (GIP) process, including:

- Developing Integrated System & Operations Planning (ISOP), which will be considered by the NCUC (page 67-70);
- Enabling grid flexibility through a smart-thinking grid that can both adjust to grid instability resulting from increased DER penetration and reroute power to prevent more customer outages when events occur (page 116);
- Exploring microgrid technologies, especially for critical infrastructure (page 117-118);
- Quantifying the human cost of power outages by using the Interruption Cost Estimate calculator, developed by the Department of Energy and Berkley National Labs, to value the benefit of reduced outages and outage time for customers when evaluating grid resiliency investments (page 120); and
- Offering customers access to their usage data and innovative rate design, enabled by smart metering technology (page 125 and 129).

The company is proud of the transparent process through which it has developed the three-year GIP, including by engaging stakeholders to inform and develop the plan. The GIP does not include the base-level work that must be done to maintain service quality for customers, but does include programs to meet new challenges and optimize grid functionality for the 21st century. While some of the programs in the GIP that optimize Duke Energy's grid by addressing multiple megatrends are justified by positive cost-benefit analyses, Duke Energy disputes that all grid investments must be justified by a positive cost-benefit analysis using monetized benefits only (pages 74-75). Some programs, such as physical and cyber security investments, are necessary to defend the grid against attacks. Other system-wide programs investing in communication networks, systems and equipment to provide grid automation and intelligence would not be justified on a cost-benefit basis, since they provide basic foundational functionality to establish a smart two-way thinking grid. Those programs provide a foundation upon which grid optimizing work can provide value, and without them the company would not be able to meet customer and grid needs.

Duke Energy also disputes that all its grid investments would be selected only through an ISOP process (page 76-77). While ISOP and Duke Energy's GIP share a common vision of preparing for a future where Distributed Energy Resources (DERs) are increasingly economic, the scope of ISOP is more narrowly focused on the portions of distribution and transmission planning where DERs and customer programs offer the potential to contribute to bulk generation planning needs (under the IRP) while also deferring or avoiding traditional transmission and distribution upgrade investments. Both ISOP and the GIP show that the company is fulfilling its duty to deliver value to customers today while preparing for the future.

The current GIP represents a comprehensive, foundational "no regrets" package of investments. These are essential investments that will help transition from a one-way power flow capability to a dynamic smart thinking two-way power distribution grid. Many of the investments contained in the plan such as enhanced communications, Self-Optimizing Grid, Integrated Volt-VAR Control and 44kV uplifts are foundational in nature and support a future grid with capabilities to integrate greater amounts of solar, batteries and EVs. The GIP runs these foundational investments in parallel with standing up the appropriate tools and processes that make up ISOP. Duke Energy's GIP will help prepare the state for a distributed energy future, and even incorporates distributed energy resources ahead of the industry in cases where that makes sense.

The company offers the following additional clarifying comments on this section of the report:

- Page 10: With respect to the discussion of how goals must be balanced, part of the balance is adequate supply and reliability of electricity, and the security of that supply from both physical and cyber/digital perspectives.
- Page 10: Add "security" to the list of goals in the last sentence.
- Page 19: Add "and man-made" to "strengthens resiliency against natural disasters" to recognize the growing need to protect against cyber and physical attacks.
- Page 25 and 74: The draft CEP states that: "When evaluating proposals for grid modernization, [regulators should] consider …and metrics of progress made toward grid modernization goals." These statements fail to recognize that no stakeholder, including the utility, has perfect foresight of how technologies and costs will change over time. Efforts to "measure" performance, while well intentioned, could increase costs without commensurate benefits if not reasonably scoped. Finally, any "targets and timelines" must recognize that the underlying inputs and therefore results will change over time.
- Page 43: The section on "battery" storage should include other storage technologies that can contribute to the integration of variable renewable energy, including pumped hydro.
- Page 45: The draft CEP states that "NC's rural electric cooperatives have been early implementers of advanced technology and are leading the way to increased reliability, two-way communications, load management and grid operations." North Carolina's IOUs are also leading in this area. Duke Energy's energy storage research and demonstration work includes 15 national projects that demonstrate 10 different grid applications and functions, with 8 different battery chemistries representing more than 40 MW of capacity, including projects at Mount Holly and McAlpline in North Carolina. The company has

plans for approximately 375-megawatt (MW) of energy storage across our regulated businesses, representing approximately $600 million of new investment. This includes approximately 300 MW of energy storage at various locations on our Carolinas system and in partnership with areas where it can deliver the most benefits for the grid and the local community. Duke Energy's battery storage and microgrid projects include projects at Haywood County, Rock Hill and Hot Springs in North Carolina and has plans for projects in Anderson County (South Carolina); Cape San Blas, Jennings and Trenton (Florida); and Camp Atterbury and Naab (Indiana). (See: https://news.duke-energy.com/releases/north-carolina-regulators-approve-duke-energys-innovative-microgrid-project-in-madison-county; https://www.eei.org/issuesandpolicy/Energy%20Storage/Energy_Storage_Case_Studies.pdf)

- Page 46: The draft CEP states that AMI saturation in North Carolina is only 32 percent. This number appears low, depending on AMI saturation for other utilities. As of August 2019, Duke Energy has deployed smart meters to about 80 percent of North Carolina customers (approximately 2.8 million meters out of a total of nearly 3.5 million to install). The company has completed installations for Duke Energy Carolinas and is a little more than halfway complete in Duke Energy Progress. Deployment will continue through 2021.
- Page 53: "Developing the electricity system quickly became essential…." This remains true today in a much more volatile cyber and physical security environment.
- Page 59: Expediting or fast-tracking CPCN, siting, and right of ways for new transmission and distribution infrastructure supporting distributed energy resource integration and/or serving electric vehicle charging stations could help support the goal of "modernizing the grid to support clean energy."
- Page 119: Add physical security to "coordinate security."
- Page 120: The draft CEP recommends studying the "impact of storms and cyber-attacks and including analysis of greater investment in DERs, microgrids and grid hardening." This analysis should include physical attacks and the ability for the ACP to provide natural gas as a fuel source for microgrids (especially beneficial in eastern NC).

Customer Access to Clean Energy & DER Interconnection and Compensation

At Duke Energy, the customer is at the center of the company's mission. Evolving customer expectations, emerging technologies and changing public policies all contribute to a dynamic environment for Duke Energy and the industry. Part of the company's work to transform the customer experience includes providing customers more options and control over when and how they use energy. The company is expanding options to better enable customers to access and support renewable energy. This includes programs created by HB 589 – such as solar rebates, shared solar and Green Source Advantage – and more, like the Renewable Advantage REC purchasing program, which is currently pending before the NCUC.

In addition, beginning on October 1st, the company is piloting several dynamic rate options for Duke Energy Carolinas customers enabled by smart meter technology. These pilot programs are voluntary and will help provide important information to help Duke Energy provide residential and small commercial customers with even more options to better manage their energy use.

Recommendations F-1 and F-2 address the potential for wind energy to play a larger role in North Carolina's energy future. Duke Energy has been investing in wind energy for more than a decade, and is a national leader in this area, generating 2,300 MW of wind electricity at 21 wind farms across the United States. In general, the company believes offshore wind energy has potential and could be a strong complement to the energy portfolio in the Carolinas. Given the unique characteristics of the state's load centers, a majority of which are in the western part of the state, the company would need to invest heavily in the transmission infrastructure needed to move that electricity across large distances. DEQ could consider a recommendation for expedited siting, permitting and right of ways, which could help meet this future need. Duke Energy currently has a large amount of solar in the eastern part of the state, as well as several nuclear plants serving that load. The company continues to investigate the feasibility of offshore wind, including conducting economic analyses comparing it to other technologies and stands ready to support the state in its analysis of this potential resource.

Below are several specific and clarifying comments about this section of the draft CEP:

- Page 26: Consider adding a dot in the table for legislation under "clean energy economic development opportunities" related to wind energy; current North Carolina laws contribute to limited wind development in the state.
- Page 26: Recommendation F-2 proposes an offshore wind assessment. Offshore wind may require new transmission; consider fast tracking CPCN and right of way processes for this infrastructure.
- Page 36: The draft CEP states that "how utilities comply with HB 589 will determine the level of solar capacity added in coming years." A more accurate statement would be: "The ability to safely interconnect solar facilities to the grid, with consideration for operational needs, customer demands and cost, will determine the level of solar capacity added in the coming years."

- Page 39: "North Carolina is currently ranked 7th in the nation for most installed solar capacity according to the Solar Energy Industries Association." According to SEIA's 2018 report, North Carolina is still second in the nation for installed solar capacity (See: https://www.seia.org/research-resources/top-10-solar-states-0).
- Page 40: In the discussion of wind energy's success in other states, consider acknowledging the obstacles to wind development in North Carolina. For example, "To grow wind development in North Carolina and catch up to national trends, the state may need to address military concerns and require legislative support to remove current obstacles and community and local government support to overcome NIMBY-ism."
- Page 43: The draft CEP states "comments made by the NCUC Public Staff regarding the lack of energy storage market transparency state that market participants and Duke Energy generally agree that energy storage can provide many grid benefits, such as frequency regulation, operational reserves and firm capacity; however, there is no mechanism to pay market participants for these services." A more accurate statement would be: "…, and firm capacity; however, further review would need to be conducted to determine what ancillary services could be needed and/or beneficial for the state, and how market participants may be compensated for those services, recognizing that they are bundled in the payment system the company uses today"
- Page 48: The second paragraph refers to HB 559, but should read "HB 589."
- Page 51: The following statement has no citation: "North Carolina was one of 21 states to lose solar jobs in 2018…." However, research from the nonprofit E2 provides the following assessment: "According to Clean Jobs North Carolina 2019, the state's clean energy jobs grew 3.5 percent last year – nearly double statewide employment growth (1.9 percent) —and now account for more than half of North Carolina's entire energy sector workforce (212,172). Clean vehicles led all sectors in growth, adding more than 1,000 jobs for a 19.5 percent growth rate" (See: https://www.e2.org/wp-content/uploads/2019/07/E2-Clean-Jobs-North-Carolina-2019.pdf).
- Page 53: Add "primarily" before "…one-way supply of electricity from suppliers to consumers." Customer-sited Qualifying Facilities have existed since PURPA was enacted in 1978.
- Page 55: In the vision statement, strike "battery" to be inclusive of other promising storage technologies.
- Page 78: In recommendation F-2, include transmission infrastructure in the assessment of infrastructure needed for the offshore wind industry.
- Page 79: The draft CEP cites a "tension between accessibility and affordability" of renewable energy programs. These concepts may be in conflict but the tension primarily exists because solar plus storage cannot currently replace the energy provided by the utility at a cost that is lower than utility rates (which, as the draft CEP acknowledges, are low relative to other states).
- Page 79: The draft CEP cites a narrow time window for signing up for solar rebates as an obstacle to affordability and accessibility. Rephrase this statement to better clarify the underlying drivers. For example: "The rebate program has proven to be very popular because when it is combined with the economically advantageous net metering program the payback for solar is significantly reduced. Due to the total capacity limits established

in HB 589 and how quickly applications are received when the program opens, some potential customers have been unable to access a rebate."

- Page 79: While not part of HB 589, Duke Energy has also filed a REC purchasing program for residential and small and medium business customers called Renewable Advantage. This program is currently pending approval from the NCUC.
- Page 79: For Green Source Advantage, a customer may also choose a bill credit in-line with their daily energy rate. In addition, to participate a customer's demand must total at least 1MW. This should read: "The program has a carve-out for NC universities, military and customers with demand of at least 1MW."
- Page 79: The draft CEP states, "Business do not have the ability to enter into their own on-site third-party PPAs…." This should also note: "However, as established by HB 589, they can enter into a lease agreement with a similar financing structure to third-party PPAs."
- Page 79: The last paragraph on upfront cost should note that the leasing option eliminates the upfront cost of solar. The barrier to adoption is simply the economics; today, the cost of solar does not provide immediate savings due to the low cost of energy in North Carolina and many potential customers require a favorable near-term payback.
- Page 80: The following statement needs to be updated: "…while others such as the Green Source Advantage program…." This program was recently approved by the NCUC and will be available to customers starting October 1, 2019 per the NCUC order.
- Page 80: The draft CEP states, "In short existing utility incentives to increase sales make it difficult…." Duke Energy is supportive of distributed generation and is trying to make investments in the grid to support DERs.
- Page 84: The draft CEP states, "Rather, in North Carolina the compensation is based on the utility's avoided cost rate, meaning that the credit they receive is lower than the price of the energy they consume." This is not a true statement. The full retail rate is comprised of energy, capacity, transmission and distribution. The utility does not oppose crediting community solar participants with the energy and appropriate capacity value, but it is opposed to all four values being received when only up to two are provided. If the credit methodology is not tied to the value of solar (regardless of premium) non-participating customers will be subsidizing the solar (including low income customers).
- Page 88: The draft CEP states, "Duke Energy expects that the total amount of projects that will be developed under the CPRE to be in the 4200 – 4700 MW range." This is incorrect. The 4200- 4700 MW refers to the amount of solar that is now expected to be grandfathered under the legacy PURPA rules and subtracted from the CPRE target. HB 589 targeted a total of 6800 MW – an amount the system can handle according to the 2014 PNNL Study. HB 589 estimated that 2660 MW would be procured through CPRE based on the following equation: 6800 MW – 600 MW Green Source Advantage program – 3500 MW Legacy PURPA – 40 MW Shared Solar program = 2660 MW CPRE. Now the expectation is that legacy PURPA will be 4200 – 4700 which will reduce CPRE by 700 – 1200 MW. Therefore, CPRE is expected to procure 1460 – 1960 MW.

Equitable Access and Energy Affordability & Just Transition to Clean Energy

As a North Carolina company, Duke Energy understands that electricity is a significant monthly expense for many customers. That's why the company is committed to helping customers who struggle to pay for basic needs with programs and tools to reduce their energy costs and keep their power on. It is also why the company's investments in the community transcend business expenses and include support for programs that build strong and resilient communities. During the last three years, Duke Energy has averaged $22.8 million in annual charitable giving in North Carolina. Additionally, the company's employees and retirees have donated their volunteer time, averaging $6.9 million in annual value.

Duke Energy is committed to helping customers who struggle to pay for basic needs with programs and tools to reduce their energy costs and keep their power on. The company offers payment plans and other options to help customers get back on track with their bill, including – to name a few – Equal Payment Plan, Home Energy House Call, Lower My Bill Toolkit, Residential Smart Saver, Neighborhood Energy Saver and Share the Warmth programs. The Share the Warmth Fund has provided more than $25 million in assistance over the life of the program to help low-income families in North Carolina cover home energy bills, regardless of heating source.

Duke Energy actively invests in human capital to help advance the industry and the state. One example is the company's investment in training lineworkers to build an even smarter energy grid that will improve the way the company serves customers. The Carolinas Energy Workforce Consortium estimates that the industry will need 1,500 new lineworkers each year for the next 5-6 years in North Carolina to meet business needs. These clean energy jobs offer high pay and good benefits and will play a vital role in moving North Carolina's energy industry forward. Since 2014, Duke Energy has invested $41.7 million in North Carolina Community Colleges to help meet this need. These investments include support for 10 North Carolina Community Colleges providing lineworker and energy sector training to support a smarter energy future for the state.

Below are several observations intended to help inform the delicate balance that achieving the CEP's multiple goals – including affordability – will require:

- Global Observation: Throughout the draft CEP, DEQ points to states like California, Hawaii and Rhode Island as models for North Carolina. These states have some of the highest electricity rates in the country and very different heating and cooling needs. When looking to these states for lessons learned, it will be important to consider how North Carolina differs. For example, North Carolina residents commonly use electricity for both heating and cooling. Duke Energy's average customers also do not enjoy the same income levels as certain states, so rate increases are more impactful. In 2017, North Carolina had a median income of about $50,000 compared to $60,000 in California, $74,000 in Hawaii and $61,000 in Rhode Island (See: https://www.cnbc.com/2018/12/07/median-household-income-in-every-us-state-from-the-census-bureau.html). Additionally, the lack of correlation between renewables and North Carolina peak load means – especially on winter mornings – that the point of diminishing returns is reached more quickly than states with a higher correlation between renewable output and peak load. North Carolina also has a large amount of existing nuclear energy that provides 24/7 emissions-free power; during periods of low demand, there may be fewer opportunities to displace higher-emitting resources relative to other states. This can lead to a much greater financial burden for customers if not managed properly. To address these challenges, the “analysis of promising strategies” proposed on page 5 could include a quantified affordability metric, such as a price cap.

- Global Observation: Improving the resiliency of the generation, transmission and distribution systems that serve consumers across the state is a shared priority. Duke Energy is investing today in making these systems more resilient to storms and other physical threats, as well as increased cyber security threats. These improvements provide benefits across all customer segments and income levels. Historically, low-income citizens bear more of the burden of significant storms, such as Hurricanes Matthew and Florence, which posed massive flooding and long-lasting damage to low-lying areas. Those customers face not only costs to repair or replace damaged property but also the increased systemwide cost of paying for storm restoration. With the increased likelihood of more severe storms due to climate change, Duke Energy has proposed securitization as a means of lowering customer financial impacts from storms.
- Page 27: Recommendation H-3 aims to create long term jobs in the clean energy sector. Consider including a priority around maintaining existing carbon-free nuclear plants and their importance to the economic viability of their local communities. These facilities employ more than 5,000 workers in the Carolinas with an average salary of more than $99,000 and paid more than $308 million in property and payroll taxes in 2018. Research by Clemson University, the Carolinas’ Nuclear Cluster and E4Carolinas concludes the nuclear industry provides a total economic impact of $20-$25 Billion to the two-state Carolinas region. (See: http://e4carolinas.org/wp-content/uploads/2016/06/NC-SC_NuclearEconImpactReport.pdf).
- Page 79 and 84: The draft CEP states, “Rather, in North Carolina the compensation is based on the utility’s avoided cost rate, meaning that the credit they receive is lower than the price of the energy they consume.” This is not a true statement. The full retail rate is comprised of energy, capacity, transmission and distribution. The utility does not oppose crediting community solar participants with the energy and appropriate capacity value, but it is opposed to all four values being received when only up to two are provided. If the credit methodology is not tied to the value of solar (regardless of premium) non-participating customers will be subsidizing the solar (including low income customers). Any further study of virtual net metering should recognize this potential burden and consider opportunities to minimize or balance its impact.
- Page 95: The plan proposes to “ensure inclusion and meaningful involvement of historically marginalized individuals (people of color and people living in poverty) in decision-making regarding siting generation assets and implementing programs that would affect their rates, health and access to clean energy and energy efficiency opportunities.” This is an important goal, and Duke Energy supports the inclusion of

multiple stakeholders in a comprehensive process to evaluate asset additions. The state must work to define “meaningful involvement in decision making” to provide clarity to the utility and others involved, so processes can be adjusted accordingly. Further, the state must recognize that changes to these processes (from initial stakeholder input to local zoning to state certification and permitting processes) will increase the time and expense of facility siting required to meet the growing needs of the state.

- Pages 97 and 103: The draft CEP contemplates including environmental justice considerations in siting decisions (assigned to NCUC & DEQ). This likely requires legislation. North Carolina statutes do not provide for EJ review, except for landfills.
- Page 99: The plan appears to assume that a linear increase in achieved, dependable efficiency and demand-side management will occur through the introduction of new programs and offerings (i.e., that offering more efficiency programs and options will directly improve costs and conditions for low-income customers). It is important to recognize that the reality is more complex. Ultimately, adoption of more stringent energy-efficiency measures (unless mandated) requires changes in human behaviors.
- Page 105: The “family-sustaining” language, while laudable, was specifically inserted by a single individual to focus on creation of unionized jobs. North Carolina’s plan should be agnostic as to how good jobs are created.
- Page 106: In addition to utilities, DEQ should include other clean energy developers in the recommendation to “work with ‘high road’ contractors or those that provide living wages and benefits.”

Energy Efficiency and Demand Management

Duke Energy's energy efficiency and demand response programs are a win for everyone. In addition to energy efficiency programs (described in the company's comments related to equity and affordability), the company has demand side management and demand response programs which can be activated when generation or power purchases would be costlier for customers; or during times of capacity constraints – when generation (Duke Energy plants or other regional plants) are unavailable. These include programs for business customers that can adjust energy consumption levels during peak time periods and as well as more than 400,000 residential customers across the Carolinas, who are actively participating in residential demand side management, allowing Duke Energy to control their air conditioners during peak demand times. Combined, Duke Energy's residential DSM programs can – when activated – shave up to 961 MWs of energy off the peak.

In addition, beginning on October 1st, the company is piloting several dynamic rate options for Duke Energy Carolinas customers enabled by smart meter technology. These pilot programs are voluntary and will help provide important information to help Duke Energy provide residential and small commercial customers with even more options to better manage their energy use.

Based on extensive experience delivering successful energy efficiency and demand management programs across the company's seven jurisdictions, Duke Energy offers the following observations and clarifying comments about these priorities in the draft CEP:

- Page 41 and 45: It is important to clarify that programs that use "price signals" also allow a customer to "buy through" an event. This can make the utility financially whole, but it does not reduce the need for a system with enough excess capacity to allow for these customers to ignore the signal and not reduce their demand.
- Page 69: The draft CEP recommends "identification of locational value for nodes on the distribution system where DER deployment could provide grid services." Assuming a methodology can be created for location value, does the DEQ propose that the Avoided Costs used to determine cost effectiveness of EE and DR (and DER) programs could be different across the system based on location? If so, a new mechanism for cost recovery will be required which accommodates these different values. Potential unintended consequences should also be considered. For example, customers on opposite sides of the same street, but on different circuits, could be paid significantly different incentives for the same actions. Or, if circuits without constraints (and therefore lower avoided costs) happen to be in low-income areas, the cost effectiveness of these programs would be eroded.
- Page 72 and 97: "Inclusion of Non-Energy Benefits in cost effectiveness test" has been considered and reported out to the Commission as part of Duke Energy's EE Collaborative. As that report summarizes, Collaborative members seemed to agree that NEBs do exist; however, there was no definitive source for an appropriate quantification of NEBs when determining program cost effectiveness.
- Page 82: It is important to remember that while PAYS has proven effective on a small scale for cooperative utilities like Roanoke EMC, the scale of an IOU program would

likely be very different and creating an additional charge that adds to customer bills may lead to additional disconnects. A customer participating in an on-bill program may choose increased comfort or function at the same usage instead of the same comfort or function level at lower usage.

- Page 97: With respect to "equity metrics," to the extent possible, Duke Energy already tracks EE participation to understand the socio-economic segments that are participating in programs. Additionally, Duke Energy has specific programs targeted at multi-family and low-income customers. The company currently tracks and reports participation and impacts at this program level.
- Page 101: Related to the recommendation to "create carve outs," getting low income customers to participate in "carve out programs" is not always the easiest or most cost-effective way to deliver EE to low-income customers. A great example is a Duke Energy program dedicated to providing low-income customers with energy efficient bulbs. Ultimately, the company found that it cost significantly less and was more effective to reach low-income customers with efficient lighting through a mass market EE lighting program.
- Page 101: "Discuss new program ideas:" This should be a short-term action item. These conversations are ongoing within the existing EE Collaborative. Also, the recommendation should include all utilities.
- Page 104: The proposed apprenticeship program will help build a qualified workforce of trade allies to implement EE. Utilities should be included as a stakeholder.
- Page 112: In Table I-1 under "Create mechanisms to effectively utilize EE..." it should be noted that EE should focus on winter peak shaving since that is driving capacity needs.
- Page 124: Utilities, including but not limited to Duke Energy, should be represented on the proposed Energy Efficiency Advisory Council.
- Page 125: The recommendation to provide Green Button Download My Data consistent functionality is an expectation associated with AMI deployment. Duke Energy believes that this functionality will be available to customers later this year and will provide a significant opportunity to learn about customer interaction with usage data. Duke Energy plans to actively participate in the NCUC's work regarding the potential for utilities to provide automatic flow of usage data to third parties at a customer's request.
- Page 126: Duke Energy does not believe that specific EE targets or requirements are necessary. However, the proposal to maintain the current ceiling for EE inclusion in REPs as a floor for EE used to meet the increased 2021 REPS requirement is likely an approach that Duke could comply with, if the calculation methodology for EE REPS credits does not change. At some point, it is possible this could cause an increase in the overall REPS compliance cost because there is no flexibility to use a lower percentage of EE if renewable alternatives are a less expensive manner to comply.
- Page 127: The recommendation to "enhance education" currently ignores the existing K-12 EE program that already provides some educational curriculum to schools. In addition, utilities should be considered stakeholders alongside those listed in the action recommendation on page 128.
- Page 129: The recommendation for innovative rate design pilots is consistent with current expectations. However, one important consideration around time-differentiated

rate designs is the overlap with existing and potential new demand response programs. Additionally, voluntary time-differentiated rates have the potential to decrease utility revenue but not peak demand if the customers that elect to adopt are “natural winners” who do not need to change their consumption patterns to benefit from lower prices during off-peak hours.

- Page 131: “Update Building Code:” While Duke Energy does not oppose this recommendation, it is important for the final CEP to make readers and policy advisors aware that increasing the energy efficiency requirement in the Energy Conservation Code will reduce the cost effectiveness of EE programs and potentially reduce the total potential for energy savings under utility programs. This due to the fact utility programs only get credit for energy savings above and beyond the building code and efficiency standards.

Transportation Electrification

Supporting the use of electric transportation is a Duke Energy priority that will benefit communities, customers and the state's future. Transportation contributes over 30 percent of greenhouse gas emissions in North Carolina, and EVs are already cleaner than conventional vehicles with the generation mix that exists today (See: https://www.ucsusa.org/sites/default/files/attach/2015/11/Cleaner-Cars-from-Cradle-to-Grave-exec-summary.pdf).

While managed charging will become increasingly important as EV adoption grows, there is little evidence that EV-specific utility rates drive EV adoption. Therefore, the greatest emphasis should be placed on driving adoption with incentives and utility investment in fast charging infrastructure.

As part of a commitment to build a cleaner and smarter North Carolina, Duke Energy is proposing the largest investment in electric vehicle (EV) infrastructure ever in the Southeast – a $76 million initiative to spur EV adoption across the state. In a filing with the North Carolina Utilities Commission (NCUC), the company outlined a watershed program that will provide incentives to customers. This program will also lead to a statewide network of fast-charging stations to meet growing demand. The three-year program requires NCUC approval.

The proposed initiative before the NCUC has several components:

Residential EV Charging: This program will provide a $1,000 rebate for qualifying Level II charging stations for up to 800 residential customers. Level II charging allows customers to charge their EVs up to six times faster than a standard wall outlet.

Public Charging: Duke Energy will install and operate more than 800 public charging stations across North Carolina, including DC Fast Charging, Public Level II and multifamily locations, which will expand the state's network of EV charging stations.

Fleet EV Charging: The program will provide a $2,500 rebate for 900 qualifying charging stations for commercial and industrial customers who operate fleets that are transitioning to electric and plug-in hybrid vehicles. Municipalities and universities also qualify for these rebates.

EV School Bus Charging Station: Duke Energy will provide financial support to eligible customers to procure up to 85 electric school buses. Duke Energy will install the associated charging infrastructure.

EV Transit Bus Charging Station: Duke Energy will install and operate more than 100 electric transit bus charging stations for eligible transit agencies electing to procure electric buses. Electric transit buses eliminate diesel emissions and reduce fuel and maintenance costs for transit agencies.

The final CEP should explicitly promote programs that drive EV adoption and accelerate the build-out of electric transportation infrastructure. This would complement the Department of Transportation's ZEV plan under Executive Order 80 and build upon the state's strong progress reducing emissions from the electricity sector.

DEQ could also consider other policy recommendations to increase EV adoption and leverage emissions reductions in the electricity sector to further reduce emissions from transportation. For example, DEQ could recommend that the legislature pass electric vehicle targets or incentive mechanisms to promote adoption. These incentives could scale down over 4 to 5 years as electric vehicles more available and cost competitive. Currently, the ten states that have already adopted targets or incentives are dominating the limited availability of electric vehicle options in the United States, and this is likely to continue.

Finally, as electric transportation expands, transmission and distribution investments may be needed to serve charging at scale. DEQ could consider a recommendation for expedited siting, permitting and right of ways, which could help meet this future need.

North Carolina
Clean Energy Plan

Transitioning to a 21st Century Electricity System

POLICY & ACTION
RECOMMENDATIONS

October 2019

THE GREAT SEAL OF THE STATE OF NORTH CAROLINA
MAY 20, 1775
APRIL 12, 1776
ESSE QUAM VIDERI

NORTH CAROLINA
Department of Environmental Quality
State Energy Office

A strong clean energy economy creates good jobs and a healthy environment.

Acknowledgements

This North Carolina Clean Energy Plan (CEP) is prepared by the North Carolina Department of Environmental Quality (NCDEQ) to foster and encourage the utilization of clean energy resources and the integration of those resources to facilitate the development of a modern and resilient electric grid as directed in Executive Order 80 which was signed by Governor Roy Cooper on October 29, 2018.

NCDEQ recognizes and thanks representatives of the Regulatory Assistance Project (RAP) and the Rocky Mountain Institute (RMI) for providing technical guidance and facilitation support throughout the CEP development process. Special thanks is extended to the Duke Nicholas Institute for Environmental Policy Solutions at Duke University and North Carolina Clean Energy Technology Center at NC State University for reviewing and providing feedback on drafts of the CEP. Appreciations are also extended to the North Carolina Utilities Commission and the NCUC Public Staff for providing guidance and perspectives during the development of the CEP.

NCDEQ is thankful to the organizations and individuals that contributed to the development of the CEP through participation in stakeholder engagement activities. Four methods of stakeholder engagement were offered allowing organizations and individuals to contribute to the CEP including: facilitated workshops, regional listening sessions, other statewide events and online input. A complete list of the 166 organizations that participated in stakeholder engagement through these four methods is provided in the Supporting Documents.

NCDEQ is also thankful to contributors who participated in this process in special ways. These special contributors to the CEP development process include the following:

<u>Facilitated Workshop Presenters:</u>
North Carolina Clean Energy Technology Center, Duke Nicholas Institute for Environmental Policy Solutions, UNC Chapel Hill School of Law, Energy Production and Infrastructure Center at UNC Charlotte, North Carolina Sustainable Energy Association, North Carolina Electric Cooperatives, Advanced Energy Economy, Gridlab, Duke Energy, Resources for the Future, Environmental Defense Fund's Cities Initiative, CERES, Litz Strategies and Georgetown Climate Center, Natural Resources Defense Council and E4 Carolinas.

<u>Facilitated Workshop Hosts:</u>
Nature Research Center at NC Museum of Natural Sciences and NCSU's McKimmon Conference and Training Center.

<u>Regional Listening Session Hosts:</u>
UNC Charlotte, The Collider in Asheville, The Rocky Mount Event Center, Fayetteville State University, Western Piedmont Council of Governments in Hickory, Museum of the Albemarle in Elizabeth City, Cape Fear Community College in Wilmington, and NCA&T State University.

<u>Energy Modeling Organizations:</u>
Resources for the Future, Natural Resources Defense Council, NC State University, Environmental Protection Agency, Georgetown Climate Center, NC Sustainable Energy Association.

In addition, other organizations offered technical information and guidance during the development of the CEP such as National Governor's Association, U.S. Department of Energy, National Association of State Energy Officials, Virginia's Department of Mines, Minerals and Energy, Massachusetts' Department of Energy Resources, New Jersey's Department of Environmental Protection and New York State Energy Research and Development Authority.

A very special thanks to all NCDEQ staff that contributed to the development of the CEP.

Preface

The Clean Energy Plan was written by the Department of Environmental Quality as directed by Executive Order No. 80..[1] DEQ was tasked with the creation of a CEP to encourage the use of clean energy resources and technologies and to foster the development of a modern and resilient electricity system. The purpose of the CEP is to outline policy and action recommendations that will accomplish these goals. The CEP is made up of the main document titled *Policy and Action Recommendations* and six supporting documents.

Part 1: Energy Sector Profile and Landscape

Part 2: North Carolina's Energy Resources

Part 3: Electricity Rates and Energy Burden

Part 4: Stakeholder Engagement Process and Comments

Part 5: Energy and Emissions Modeling

Part 6: Clean Energy Jobs and Economic Outlook

The CEP uses best available data, analysis, and stakeholder input to examine what our electricity system should look like in 2030 and what values we must retain moving forward. It identifies achievable goals, proposes modern policies and strategies to achieve the goals, and identifies activities needed to adjust the regulatory framework to accommodate 21st century customer expectations, public policy goals, energy needs, economic development opportunities, and societal outcomes related to climate change.

The policies and strategies identified here are intended to provide policy makers, regulatory bodies, local governments, and others with a high-level implementation plan for achieving the goals and targets set in the CEP. When viewed collectively, these strategies should help develop a broad, clear picture of the actions North Carolina can undertake to maximize energy, economic and environmental benefits.

Promising strategies and actions will require further deeper dives and detailed analysis when considering proposing new legislation or amending existing policies and procedures. The CEP presents short term (less than 12 months), mid-term (1-3 years), and longer term (3-5) actions to ensure the State's energy needs are served in a cost-effective, reliable and sustainable manner. The longer term action (3-5 years) also consists of assessing the accomplishments made, consideration of technology advancements, and a relook at the strategies and actions to take in the future. In summary, these policies and strategies will provide stakeholders a common understanding of the vision and direction which we want to move towards.

[1] https://files.nc.gov/ncdeq/climate-change/EO80--NC-s-Commitment-to-Address-Climate-Change---Transition-to-a-Clean-Energy-Economy.pdf

Contents

Executive Summary

EXECUTIVE SUMMARY

Climate change is an increasing threat to the health, safety and prosperity of North Carolinians. At the same time, the clean energy economy is creating opportunities to create jobs and propel North Carolina to be globally competitive. On October 29, 2018, Governor Roy Cooper signed an executive order calling for a 40 percent reduction in statewide greenhouse gas emissions by 2025. The order tasked the Department of Environmental Quality with developing a clean energy plan for North Carolina.

After an extensive stakeholder engagement process, including meetings and public comment periods, the plan was presented to Governor Cooper on September 27, 2019. Over the last 10 months, utilities, policymakers, regulators, universities, non-profits, the public, and industry experts have offered their expertise to help craft the plan, which is a holistic vision for the clean energy future of our state. More than 160 stakeholder groups helped develop this shared vision for North Carolina's energy future.

- Multiple sessions were held over a period of six months in geographically diverse venues across the state.
- Feedback was collected through facilitated workshops, regional listening sessions, at energy related events and through online/direct input – culminating in a draft report that was released for public comment.

Building on Existing Accomplishments

North Carolina has built an impressive record on clean energy, but to continue that leadership the strategies laid out in this plan must inform the legislative and policy changes the state adopts.

The rapid pace of economic, environmental, and technological change has created an opportunity for North Carolina to pursue a modern, 21st century electricity system. By leveraging the State's existing energy resources, innovative public and private sector partners and a competitive workforce, North Carolina is positioned to help drive a larger transition to a clean energy economy. The Clean Energy Plan is presented as a framework to accelerate that process.

Drivers of Transformation

The declining costs and large-scale deployment of renewable energy systems and the rapid advancement of information management, communications, and consumer product devices are transforming both the electricity supply and public demand for our electrical grid. These forces are driving decarbonization of the electric power sector while creating economic development opportunities in both urban and rural areas of the state.

North Carolina will need to design policies that provide certainty in the marketplace with enough flexibility to support innovation and creativity to adapt to the rapidly changing demands for electricity. New technologies can drive cost savings for customers, notably incentives and rate structures must modernize to achieve the values and goals prioritized in this document.

Clean Energy Plan Goals

- Reduce electric power sector greenhouse gas emissions by 70% below 2005 levels by 2030 and attain carbon neutrality by 2050.
- Foster long-term energy affordability and price stability for North Carolina's residents and businesses by modernizing regulatory and planning processes.
- Accelerate clean energy innovation, development, and deployment to create economic opportunities for both rural and urban areas of the state.

Key Recommendations

The Clean Energy Plan (CEP) is designed to be a living document that can be modified as needed. While it lays out a vision through 2030, the intention is for revisions to be made every 3-5 years.

Recommendations in this document are divided into action items intended to fall into one of three categories: short-term (1 year), medium-term (1-3 years), and long-term (3-5 years). Many of these recommendations and action items are interconnected, but not interdependent.

To successfully transition to a clean energy future, North Carolina must establish a 21st century regulatory model that incentivizes business decisions that benefit both the utilities and the public in creating an energy system that is clean, affordable, reliable, and equitable. The following overarching recommendations are critical to the transition and will drive the priorities identified by the stakeholders:

- Develop carbon reduction policy designs for accelerated retirement of uneconomic coal assets and other market-based and clean energy policy options.

- Develop and implement policies and tools such as performance-based mechanisms, multi-year rate planning, and revenue decoupling, that better align utility incentives with public interest, grid needs, and state policy.

- Modernize the grid to support clean energy resource adoption, resilience, and other public interest outcomes.

Next Steps

This plan is intended to guide the direction North Carolina takes in adapting to a changing economy, climate, and market and help shape what change looks like, the timeframe in which change happens, and how changes impact ratepayers.

OVERVIEW OF STRATEGY AREAS & RECOMMENDATIONS

Carbon Reduction (A)

A. Decarbonize the electric power sector **Page 55**

- A-1. Deliver a report that recommends carbon-reduction policies and the specific design of such policies that best advance core values, such as GHG emission reductions, electricity affordability, and grid reliability. The report will evaluate policy designs for the following carbon reduction strategies:
    1. Accelerated coal retirements,
    2. Market-based carbon reduction program,
    3. Clean energy policies, such as an updated REPS, clean energy standard, and EERS, and
    4. A combination of these strategies.

    Legislature, State Agencies, Academia
- A-2. Require integrated resource plans and distribution system plans to use portfolios and action plans that incorporate a cost of carbon into the portfolio or plan that is selected for use by the utility.

    Utilities Commission, Investor Owned Utilities, State Agencies

Utility Incentives and Comprehensive System Planning (B-C)

B. Modernize utility tools and incentives **Page 65**

- B-1. Launch a North Carolina energy process with representatives from key stakeholder groups to design policies that align regulatory incentives and processes with 21st Century public policy goals, customer expectations, utility needs, and technology innovation.

    Governor's Office, Legislature,
- B-2. Encourage use of pilot programs or other methods for testing and evaluating components of a performance-based regulatory framework.

    Utilities Commission, Investor Owned Utilities
- B-3. When authorizing "securitization" as a utility financing tool, include uneconomic generation assets in the scope of what can be securitized

    Legislature, Utilities Commission
- B-4. Initiate a study on the potential costs and benefits of different options to increase competition in electricity sector, including but not limited to joining an existing wholesale market and allowing retail energy choice.

    Legislature, State Agencies

C. Require comprehensive utility system planning processes **Page 74**

- C-1. Establish comprehensive utility system planning process that connects generation, transmission, and distribution planning in a holistic, iterative and transparent process that involves stakeholder input throughout, starting with a Commission-led investigation into desired elements of utility distribution system plans.

    Utilities Commission, State Agencies, Investor Owned Utilities, Co-Ops/Public Utilities, Local Government, Academia, Businesses

- C-2. Expand cost-benefit methodologies used to make decisions about resources and programs to include societal and environmental factors

  Utilities Commission, Co-Ops/Public Utilities
- C-3. Implement competitive procurement of resources by investor-owned utilities

  Utilities Commission

Grid Modernizations and Resilience (D-E)

D. Modernize the grid to support clean energy resources **Page 82**

- D-1. When evaluating proposals for grid modernization, consider whether the following outcomes are supported:
  - Demonstrated net benefits for all proposed investments, including presentation of all costs and benefits used in utility analyses
  - Enhanced transparency of regionally appropriate DERs, grid needs and opportunities for DERs to interconnect
  - Increased customer access to their usage data and sources of energy
  - Facilitation of greater utilization of storage, demand-side resources, grid operation/management devices, and the bi-directional flow of power
  - Measurement of performance to ensure anticipated benefits are delivered and accounted for
  - Increased deployment of clean energy

  Utilities Commission, Co-Ops/Public Utilities
- D-2. Use comprehensive utility planning processes to determine the sequence, needed functionality, and costs and benefits of grid modernization investments. Create accountability by requiring transparency, setting targets, timelines and metrics of progress made toward grid modernization goals.

  Utilities Commission, Co-Ops/Public Utilities

E. Strengthen the resilience and flexibility of the grid **Page 87**

- E-1. Require utilities to develop projects focused on DERs, community solutions, and microgrids at state facilities and critical infrastructure locations (e.g. hospitals, shelters) to enhance resilience.

  Utilities Commission, State Agencies, Investor Owned Utilities, Co-Ops/Public Utilities, Local Government
- E-2. Coordinate resilience planning with disaster recovery operations center and require NC Emergency Management's Recovery Support Functions to address cybersecurity concerns in conjunction with energy resiliency issues.

  Utilities Commission, State Agencies, Investor Owned Utilities, Co-Ops/Public Utilities

- E-3. Develop a method to quantify the human costs of power outages, and integrate these costs when evaluating grid modernization plan components related to resiliency.

  Utilities Commission, State Agencies, Academia

Clean Energy Deployment and Economic Development (F-H)

F. Enable customers to choose clean energy **Page 92**

F-1. Consider revisions to clean energy programs authorized by HB 589 to ensure successful delivery of desired outcomes, such as increasing customer access to clean energy.

Legislature, State Agencies

- F-2. Enact a statewide commercial Property Assessed Clean Energy (PACE) and Pay as You Save Program
  Legislature, Governor's Office, State Agencies, Local Government, Academia
- F-3. Develop a green energy bank or statewide clean energy fund to catalyze the development and expansion of clean energy markets by connecting private capital with clean energy projects.
  Governor's Office, Local Government, Academia
- F-4. Require utilities to offer virtual or group net metering to enable greater access to community solar.
  Legislature
- F-5. Increase the existing REPS or create a new policy with zero-emitting resource targets without carve-outs for specific resources
  Legislature, Utilities Commission

G. DER interconnection and compensation for value added to the grid **Page 101**

- G-1. Develop rates that provide accurate price signals to demand-side resources about costs and value to the grid, such as Time of Use (TOU) or real time pricing. In the long term, consider establishing new rate and compensation structures for DERs based on the value of grid services that can be provided by DERs, such as a "value of DER" tariff.
  Utilities Commission, Co-Ops/Public Utilities
- G-2. Consider ways to provide greater transparency of system constraints and optimal locations for distributed resources
  Utilities Commission

H. Clean energy economic development opportunities **Page 107**

- H-1. Identify and advance legislative and/or regulatory actions to foster development of North Carolina's offshore wind energy resources
  State Agency
- H-2. Create and foster statewide and regional offshore wind collaborative partnerships with industry, the public, stakeholders, and neighboring states to bring economic growth to North Carolina.
  Governor's Office, State Agencies, Investor Owned Utilities, Local Government, Academia, Businesses
- H-3. Conduct an assessment of offshore wind supply chain and ports and other transportation infrastructure to identify state assets and resource gaps for the offshore wind industry.
  State Agencies, Local Government, Businesses
- H-4. Develop pathways to expand renewable natural gas recovery and usage
  Academia, State Agencies, EPC

Equitable Access and Just Transition (I-J)

I. Address equitable access and energy affordability **Page 112**

- I-1. Include non-energy equity-focused costs and benefits in decisions regarding resource needs, program design, cost-benefit analyses, and facility siting.
  Utilities Commission, State Agencies, Investor Owned Utilities, Co-Ops/Public Utilities, Local Government

- I-2. Examine the feasibility and proper design of a low-income rate class and associated rate structures, including but not limited to the elimination or reduction of fixed charges for ratepayers with high energy burdens.
  Academia, NCUC
- I-3. Expand energy efficiency and clean energy programs specifically targeted at underserved markets and low-income communities.
  Legislature, State Agencies, Others

J. Foster a just transition to clean energy **Page 120**

- J-1. Ensure inclusion and meaningful involvement of historically marginalized individuals (people of color and people living in poverty) in decision-making regarding siting electricity generation assets and implementing programs that would affect their energy bills, health, and access to clean energy and energy efficiency opportunities.
  Utilities Commission, State Agencies
- J-2. Launch an EE Apprenticeship program within Apprenticeship NC to expand access to clean energy careers.
  Academia
- J-3. Create long term jobs with family sustaining wages and benefits in renewables and grid infrastructure industries for low income communities and workers displaced by the transition to a clean energy economy.
  Legislature, Governor's Office, State Agencies, Investor Owned Utilities, Co-Ops/Public Utilities, Local Government, Academia, Businesses

Energy Efficiency and Beneficial Electrification (K-L)

K. Increase use of energy efficiency & demand side management programs **Page 125**

- K-1. Establish an Energy Efficiency Advisory Council (EEAC) to oversee implementation of the EE Roadmap recommendations
  Governor's Office
- K-2. Enable customers to have greater access to their energy data through new functionalities, such as those available through Green Button "Download My Data" Button
  Legislature, Utilities Commission, State Agencies, Investor Owned Utilities, Co-Ops/Public Utilities
- K-3. Establish minimum EE goals within existing REPS or establish an energy efficiency resource standard (EERS)
  Legislature, Utilities Commission
- K-4. Enhance education and awareness around energy efficiency opportunities in K-12 schools and community colleges through an "Energy Efficiency Everywhere (E3)" project
  Academia
- K-5. Require utilities to develop innovative rate design pilots to encourage customer behavior that helps achieve clean energy goals, such as peak demand reduction, better utilization of renewable resources, and strategic storage deployment.
  Utilities Commission, Co-Ops/Public Utilities
- K-6. Increase EE awareness on the North Carolina Building Code Council
  Legislature, State Agencies

L. Create strategies for electrification **Page 137**

- L-1. Require utilities to develop innovative rate design pilots for electric vehicles to encourage off-peak charging of vehicles and to test effectiveness of different rate structures at shifting customer usage of the grid and encouraging the adoption of electric vehicles.

  Utilities Commission, Co-Ops/Public Utilities

- L-2. Conduct an analysis of the costs and benefits of using electrification to reduce energy burden and GHG emissions in consumer end-use sectors in NC, such as in homes, buildings, transportation, industrial and agricultural operations.

  Academia

Detailed Report

NC CLEAN ENERGY PLAN

1. NC's Current & Anticipated Energy Landscape

The electricity consumed in NC (NC) homes, businesses, and industries is mostly generated at central power stations, transported through a network of high-voltage transmission lines, and distributed via local poles and wires to customers. Figure 1 shows the current capacity levels and electricity generation by resource type. These resources produced 3% of the nation's power output, ranking NC as the 8th largest electricity generating state for both 2017 and 2018.[1] Traditional fuel resources such as coal, natural gas, and nuclear stations represented about 90% of the annual output. NC's coal-fired and natural-gas fired power plants are ranked 11th and 5th in the nation, respectively, for the amount of electricity generated in both 2017 and 2018.[2]

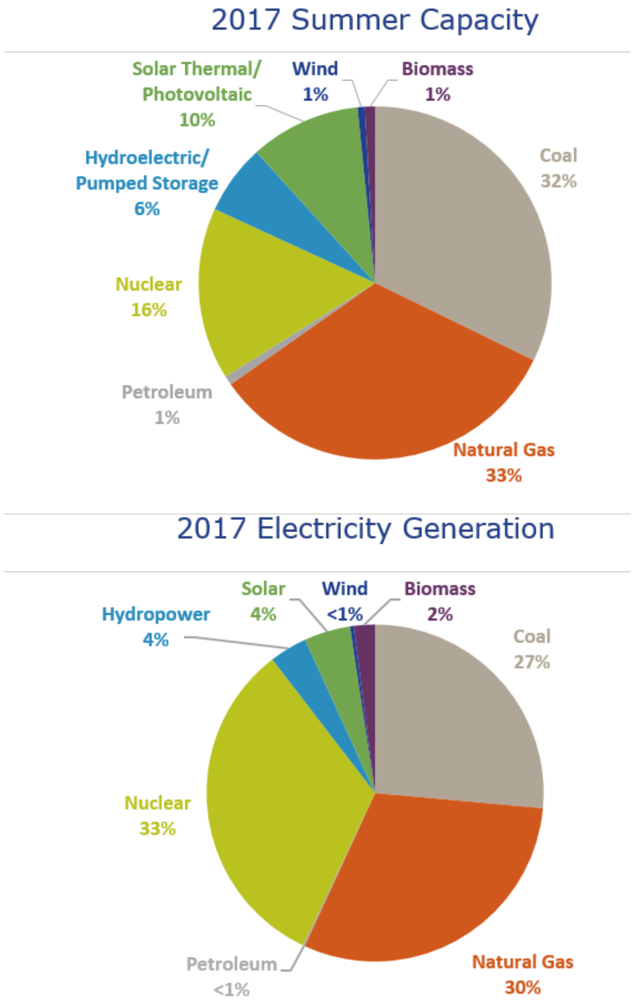

Figure 1: NC's Electricity Statistics by Resource Type

Since the enactment of the NC Renewable Energy and Energy Efficiency Portfolio Standard (REPS)[3], the capacity of clean energy resources has increased dramatically. NC's interpretation of the 1978 federal mandate, the Public Utility Regulatory Policies Act (PURPA), provided historically generous and long term "avoided cost" contracts for utility scale solar projects and is another growth driver of utility-scale solar in the state.[4] NC's Business and Energy Tax Credits provided a 35% state tax credit for renewable energy projects. These credits doubled every year after the REPS was established in 2007 and grew to $245

[1] U.S. Energy Information Administration, Electricity Data Browser, https://www.eia.gov/electricity/data/browser/
[2] Ibid
[3] Session Law 2007-397, "NC's Renewable Energy and Energy Efficiency Portfolio Standard (REPS), August20, 2007, http://www.ncuc.commerce.state.nc.us/reps/reps.htm.
[4] EIA. (2019). Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=27632

million in 2016, the last year of the program.[5] When coupled with a 30% federal solar tax credit, project developers were able to cut the cost of a renewable facility in half. The collective impact of state and federal policies and precipitous decline in solar costs led to NC being ranked 2nd in the nation for the most installed solar photovoltaic (PV) capacity. This infrastructure produced between 10 and 11% of the nation's total solar electricity output, ranking NC as the 2nd highest solar producing state each year from 2017 through 2019 (as of May).[6] Independent power producers accounted for over 92% of NC's solar generation, while utilities represented about 6% and commercial sector represented 2% of the state's solar electricity generation.

The state subsidy for solar PV expired in 2015 and the federal tax credit is slated to expire in 2021.[7] Going forward, the next phase of growth in the clean energy sector will be determined by legislation passed in 2017 called the Competitive Energy Solutions for NC, also known as House Bill (HB589).[8] This bill creates new programs for competitive renewable energy (RE) procurement, solar rebates and leasing, community solar, and special studies related to RE. The solar capacity projected to be added to the system is about 4,000 megawatts (MW) by 2025 (essentially doubling the capacity shown in Figure 1 if all the requirements in the legislation are fulfilled).

The 2018 latest Integrated Resource Plans (IRPs) filed by NC's investor owned utilities (IOUs) indicate that the capacity of solar PV will remain at about the same level from 2025 to 2030. The capacity of energy storage is planned to increase from the current level of 1 MW to 246 MW by 2025 and 291 MW by 2030. The IRPs suggest that an additional 7,200 MW of natural gas capacity will be part of NC's portfolio (18% increase relative to Figure 1) and 4,000 MW of coal capacity will be retired (12% decrease relative to Figure 1).

In the wake of continuing declining costs of renewable generation and battery storage options, NC regulators and policy makers will be called upon to evaluate the economic viability of traditional infrastructure projects whose costs will be borne by ratepayers for years to come. As NC makes capital investment decisions for future capacity additions, it will be important to select the cost-effective system that maintains affordability, reliability, equity, grid efficiency, and economic viability. In just the past year, many states and utilities have made groundbreaking announcements, some of which are highlighted below:

- Georgia state regulators approved Georgia Power's long-term IRP, authorizing the utility to own and operate 80 MW of battery energy storage, and add 2,260 MW of new renewables (primarily solar), growing its renewable generation to 5,390 MW by 2024 and increasing the company's total renewable capacity to 22% of its portfolio. The Georgia plan also calls for retiring five coal units, based on its Public Service Commission's analysis on coal units' economics and concluded that keeping them was costly to ratepayers, and reducing its use of natural gas, from almost half to about a third of its portfolio by 2024. Georgia Power's IRP also includes energy efficiency

[5] NCDOR. (2016). Article 3B – Business and Energy Credits. Retrieved from https://files.nc.gov/ncdor/documents/reports/2-3B-RenEngyProp2016.pdf
[6] U.S. Energy Information Administration, Electricity Data Browser, https://www.eia.gov/electricity/data/browser/
[7] U.S. Department of Energy. (2019). Expired, Repealed, and Archived NC Incentives and Laws. Retrieved from https://afdc.energy.gov/laws/laws_expired?jurisdiction=NC
[8] House Bill 589, Session Law 2017-192, NC General Assembly, 2017, https://www.ncleg.net/gascripts/BillLookUp/BillLookUp.pl?Session=2017&BillID=h589&submitButton=Go

targets 15% above previous IRPs. The utility said it added new programs for both residential and commercial customers, including an income-qualified efficiency pilot designed to help up to 500 residents reduce household energy demand by 20%.

- The Tennessee Valley Authority (TVA) recently published its 2019 Final IRP, calling for up to 14 GW of new solar energy, 5,300 MW of energy storage and 2.2 GW of energy efficiency savings by 2038. TVA plans to retire some of its coal plants, and will consider retirement of additional coal and gas-fired combustion turbines if determined cost-effective.
- Southern Company, the third largest utility in the U.S., set a long-term goal of low to no carbon operations by 2050 on an enterprise-wide basis, with an interim goal of 50% reduction by 2030. The company also committed to seeking approval of low-carbon and carbon-free resources that are in the best interest of its customers.
- Both of the primary IOUs servicing NC have set emission reduction goals. Duke Energy recently announced an entity wide goal of reducing CO_2 emissions by at least 50% from 2005 levels by the year 2030 and net-zero carbon emissions by 2050.[9] Dominion Energy has set a goal to reduce CO_2 emissions 80% by 2050 and methane emissions from natural gas assets 50% by 2030.[10]
- In Colorado, Xcel Energy's recent requests for proposals have set record-low prices, receiving solar-plus-storage bids as low as $36 per megawatt hour (MWh), compared to $25 per MW-hour for standalone solar. Xcel plans to retire 660 MW of coal capacity ahead of schedule in favor of renewable sources and battery storage options, and reduce costs in the process.
- In the Midwest, MidAmerican will be the first utility to reach 100% RE by 2020 without increasing customer rates. Indiana's NIPSCO will replace 1.8 gigawatts (GW) of coal with wind and solar.
- In Oklahoma, NextEra Energy Resources will develop the largest hybrid renewable project in the United States, a 700 MW facility that will serve 21 utility members and other customers of Western Farmers Electric Cooperative.
- Dominion has expressed the possibility of developing more than 2,000 MW of offshore wind off the Virginia coast. Dominion's Power Generation Group subsidiary plans to invest $1.1 billion through 2023, $300 million of which will be used towards its offshore wind.

As RE and distributed energy resources (DER) costs continue to fall and penetration rises, these assets will reach a point where they can be treated as a true grid resource, providing services that benefit both the customer and the utility. Intelligently managed DERs could offer a vision of a world where demand may be as easily dispatchable as supply. NC regulators and policy makers will be called to 1) evaluate the amount of RE and DERs that can be technologically integrated, 2) resolve grid balancing and operability issues that come with increasing quantities of non-dispatchable generation, and 3) ensure fair and equitable methods to pay for the transitioning power grid. Additionally, the forthcoming utility proposal for smart grid initiatives and grid modernization will require a substantial investment, posing a challenge to keep rates low and still maintain reliability.

Our state enjoys some of the lowest retail electricity prices in the nation, with a ranking in the bottom 10 states for the past several years. NC's average residential rate has been about 6% less than the South Atlantic region and about 11% less than the nation as a whole since 2015. Despite having low rates, NC is number 25 in the nation for average monthly residential bills (the total amount that customers pay for

[9] https://news.duke-energy.com/releases/duke-energy-aims-to-achieve-net-zero-carbon-emissions-by-2050
[10] Dominion Energy comment letter to DEQ on the draft Clean Energy Plan.

electricity service per month).[11] In other words, in 26 states residential customers have lower bills than their NC counterparts. This is one of the reasons that low-income households continue to pay a significant portion of their annual income on energy bills. In 2018, 15% of NC's residents (1.4 million) were living below 100% of the federal poverty level (FPL). On average, these individuals spent 18 to 33% of their annual income on energy bills, of which about 20% went to pay electric bills. Comparatively, the energy burden for those at 200% above the FPL ($50,000) was only 7%.[12] Public policy focusing on energy rates, equitable access, and a just transition to clean energy economy is needed to address the current disparity.

Moving forward, electricity prices for generation are projected to decline rapidly while the transmission and distribution related prices will increase to accommodate both grid scale RE and DERs. According to the Annual Energy Outlook (AEO) 2019 forecast, it is projected that the total electricity price (sum of generation, transmission, and distribution) will decline slightly or remain the same relative to the 2018 levels (see Figure 2).

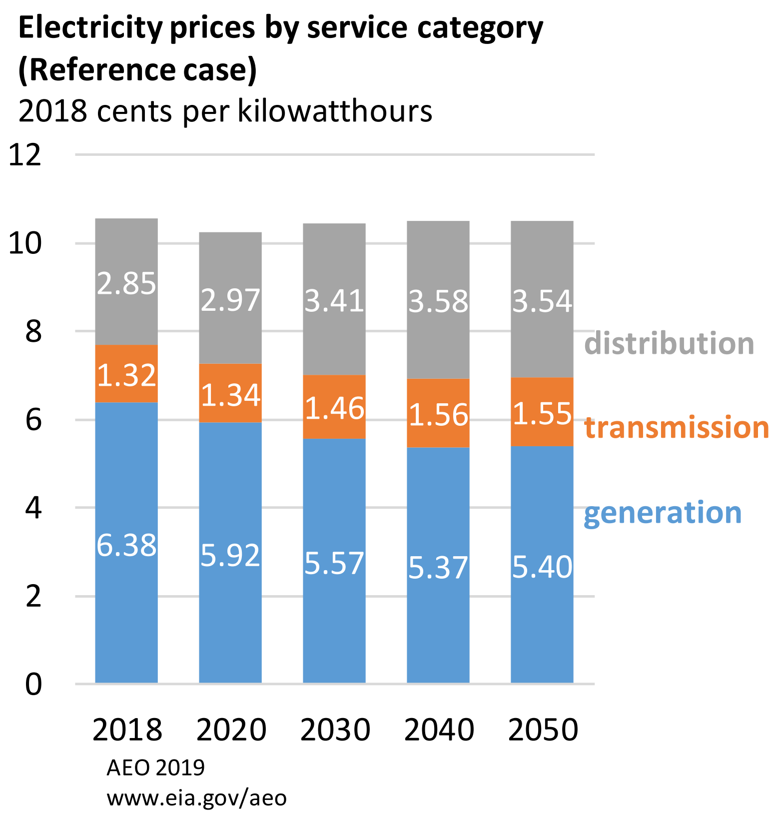

Figure 2: Electricity Prices by Service Category (Reference Case)

In the coming years, our infrastructure will be challenged to deliver smart and resilient energy, due to the technological changes and climate impacts and that are on the horizon. It is neither feasible nor prudent to build out the entire transmission or distribution system simultaneously, but there is a growing recognition that changes are needed sooner than planned, to stay ahead of the rapidly changing industry. Therefore, it is important for NC to establish a vision for what the modern gird should look like for NC.

With this vision, we can;

- meet the state's rapidly changing electricity market,
- deploy advanced technologies
- find value in the electric distribution system,
- create additional revenue mechanism for the utilities, customers, and system integrators, and

[11] 2017 data from EIA, Table 5.a. http://www.eia.gov/electricity/sales_revenue_price/
[12] For more information on energy burden of low-income households, see Supporting Document Part 3: Electricity Rates and Energy Burden.

- develop a competitive and vibrant new energy economy, where jobs of the future are both created and retained.

1.1 Nuclear Energy

Since the start-up of NC's first nuclear reactor in 1975, nuclear-generated electricity has become a substantial part of the states' energy landscape and it now provides approximately one-third of the electricity consumed in the state. Duke Energy operates a total of five reactors at three NC nuclear power plants, with licenses to operate between 2036 and 2046 as issued by the Nuclear Regulatory Commission. In its 2018 IRPs, Duke Energy reported that no new nuclear generation units are planned, with no anticipated nuclear retirements over the IRP planning period. Duke Energy noted that capacity uprates (an increase in the peak operating output of a facility, totaling 56 MW) are planned for the Brunswick and Harris plants during 2019 to 2028. Additional details regarding this resource, including benefits and concerns associated with its application, are highlighted in Supporting Document Part 2.

The CEP examines energy resource availability and technology trends over a planning horizon of ten years through 2030. During this time period, NC's current fleet of nuclear reactors are expected to continue to supply baseload electricity. The carbon policy analysis discussed later in the plan assumes continuous generation from the existing nuclear fleet, emitting zero tons of carbon emissions per unit of energy generated. As the expiration dates for existing power plants near, the State will need to evaluate extending the licenses (as desired by Duke Energy) for an additional twenty years or replace with other generation sources.

Several smaller scale nuclear technologies are currently being developed which may be considered by the State as options in the future. One such nuclear technology is the small modular reactor (SMR) with generating capacity of 300 MW or less. SMRs are anticipated to be less capital intensive than conventional nuclear plants which average around 1,000 MW per plant, may offer easier financing, and require shorter construction times due to in-factory fabrication. The micro-reactor, with capacity ranging between 1 and 20 MWs, can be factory-fabricated and integrated with distributed energy sources. Both technologies are under development. The U.S. Department of Energy projects that SMRs and micro-reactors could be introduced by the mid-2020s. The technical feasibility, safety and cost effectiveness of these emerging technologies will need to be considered as part of future energy portfolio for NC.

1.2 Natural Gas

Natural gas is used by the electricity generation sector as fuel for three primary types of generator systems: (1) natural gas combined cycle systems (NGCC), (2) simple cycle gas combustion turbines (NG CT) and (3) as a replacement fuel for coal in steam boilers. Between 2000 and 2017, the capacity of NC's natural gas power plants tripled as the State transitioned from coal due to (1) increased supply of natural gas from shale formations, (2) lower natural gas fuel prices, and (3) increased environmental regulations on coal-fired power plants. Since 2010, electricity generation from natural gas has increased 4.5 times. NGCC power plants are now providing about 30% of NC's electricity needs.

There are plans to build two new natural gas pipelines to bring shale gas produced in West Virginia to NC. The first pipeline is the Atlantic Coast Pipeline (ACP) which is a joint venture between Dominion Energy, Duke Energy, Piedmont Natural Gas, and Southern Company Gas. The determination of the route and the federal approval occurred during the previous administration. The project is on hold pending a Fall 2019 decision by the U.S. Supreme Court to determine whether or not to hear the case over a dispute regarding federal permits. The second pipeline is the Mountain Valley Southgate Pipeline which filed for approval in November of 2018. It is in earlier stages of development. Both projects are facing significant opposition from local communities and environmental groups.

Natural gas is composed primarily of methane, which is a greenhouse gas (GHG) with a warming potential 25 times greater than carbon dioxide (CO_2). In 2016, NC's natural gas power plants emitted about 15.7 million metric tons (MMT) as CO_2 equivalent GHGs, and emissions are expected to increase in the future.[13] During natural gas extraction, process and transmission activities, significant amounts of methane can escape into the atmosphere. The US EPA estimated that nationally, methane emissions from these non-combustion activities was approximately 164 MMT GHGs in 2016.[14] Based on the volume of natural gas consumed for electricity use in NC, it is estimated that 0.95 MMT GHGs are emitted in other states due to our usage.[15] Additionally, in state emissions from the operation of the natural gas transmission and storage system, including natural gas consumed by compressor stations and fugitive emissions, are estimated to be 1.34 MMT GHGs for 2016.

The Intergovernmental Panel on Climate Change's (IPCC) special report on the impacts of global warming of 1.5 °C above pre-industrial levels calls for reaching net zero CO_2 emissions globally around 2050 and concurrent deep reductions in emissions of non- CO_2 forcers, particularly methane.[16] In the "Systems Transitions" chapter, the IPCC notes that new natural gas power generation should be deployed in tandem with carbon sequestering technologies. Similarly, the U.S. Fourth National Climate Assessment calls for "replacing conventional, CO_2-emitting fossil fuel energy technologies or systems with low- or zero-emissions ones (such as wind, solar, nuclear, biofuels, fossil energy with carbon capture and storage, and energy efficiency measures), as well as changing technologies and practices in order to lower emissions of other GHGs such as methane, nitrous oxide, and hydrofluorocarbons."[17]

In NC, significant growth in natural gas electricity production is planned. Between now and 2022, Duke Energy plans to bring two new NGCC units online. After that, the projection relies on the Duke Energy IRPs for capacity additions. The IRPs indicate approximately 4,000 MW of new NGCC power will come

[13] NC Greenhouse Gas Inventory (1990-2030), NC Department of Environmental Quality Division of Air Quality, January 2019, accessed at https://deq.nc.gov/energy-climate/climate-change/greenhouse-gas-inventory.
[14] Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016, EPA 430-P-18-001, U.S. Environmental Protection Agency, Washington, D.C., February 6, 2018.
[15] According to the Energy Information Administration, NC consumed 1.6% of U.S. total natural gas production. Of this amount, 56% was consumed to generated electricity in the state.
[16] The Intergovernmental Panel on Climate Change, SPECIAL REPORT - Global Warming of 1.5 ºC, August 2018. https://www.ipcc.ch/sr15/
[17] USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,* Chapter 29: Reducing Risks Through Emissions Mitigation [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.

online between 2024 and 2030 and an additional 1,800 MW of NG CT will be built. The significant planned capacity additions are expected to increase natural gas supplied electricity from about 50,000 thousand MWh in 2018 to about 77,000 thousand MWh in 2030. Based on the current projections, natural gas will become NC's dominant source of electricity production as certain coal plants retire, contributing to most of the State's remaining GHG emissions (estimated to be 43 MMT by 2030 or 47% below 2005 levels). The current "business as usual" approach will not achieve the goal to reduce power sector GHG emissions 70% below 2005 unless the additional generation need is met by clean energy sources.

In the coming years, NC regulators will be making decisions regarding the utilities' requests to add new natural gas capacity to the generation fleet. These decisions will need to consider the drivers of electricity system transformation, including declining cost of clean energy technologies and the goal to decarbonize the power sector. They will also need to consider the rapidly changing market dynamics that could lead to stranded natural gas assets, and the best means to assure grid reliability and electricity affordability for ratepayers. The CEP identifies several recommendations and mechanisms to enable consideration of clean energy technologies that support NC's growing economy. Examples include incentivizing utilities for developing alternatives to capital intensive infrastructure projects, comprehensive energy system planning that considers generation, transmission and distribution system in tandem, consideration of the social cost of carbon in least cost analysis, developing clean energy policies and market-based carbon reduction program, and others.

1.3 Biomass

Electricity generated from biomass is eligible for Renewable Energy Credits (REC) as part of REPS. According to the NC Renewable Energy Tracking System (NC-RETS), in 2017, 20.2% of the State's RECs were from woody biomass.[18] According to Duke Energy's 2018 IRP, the capacity growth of biomass projects peak in 2020 at 406 MW, then steadily decline to 52 MW in 2032. The National Renewable Energy Laboratory (NREL) evaluated the levelized cost of energy (LCOE) projections for biomass plants and forecasts it to be relatively flat through 2050 due to the low heat content of biomass fuels.[19]

Currently, the wood pellet industry does not contribute to NC's energy generation portfolio and does not advance NC's clean energy economy. The wood pellets harvested from NC increase the state's carbon output during logging, processing and transportation and are burned for fuel elsewhere, mostly Europe. There are currently no known plans for the industry to become a contributor to NC's energy sector in the coming years. If this trend reverses, NC should not support activities that would increase emissions from its electricity generation sector for the reasons cited below.

Stakeholders have raised concerns regarding whether biomass or products derived from NC forests, is carbon neutral. We acknowledge the science regarding carbon neutrality and accounting methods are contentious issues. Biomass combustion releases carbon into the atmosphere at a faster pace than if the

[18] NC Renewable Energy Tracking System (NC-RETS), Feb 2019, https://www.ncrets.org/
[19] Annual Technology Baseline-LCOE, NREL, 2018, https://atb.nrel.gov/electricity/2018/index.html?t=cb&s=pr

forests were left intact to absorb and sequester carbon dioxide emitted from anthropogenic sources. Biomass energy is carbon neutral if growing the biomass removes as much CO_2 as is emitted into the atmosphere from its combustion.[20]

The method for accounting this complex issue has been studied by EPA and other national experts. EPA's Science Advisory Board remains deadlocked after years of debate on the best way to advise regulators on how to account for emissions from burning biomass. Meanwhile, in a 2018 publication, scientists concluded that the use of wood as fuel is likely to result in net CO_2 emissions and may endanger forest biodiversity.[21] Due to this uncertainty, large scale use of NC's natural resources to meet foreign markets' carbon reduction goals by taking advantage of current accounting of methodology should be challenged at the national and international level.

1.4 Biogas

NC ranks third in the nation with the most biogas potential.[22,23] Biogas refers to the recovery of methane gas from anaerobic digestion of municipal and solid waste generated from swine operations, landfills, dairy farms, wastewater treatment plants, and food waste operations. It is also commonly referred to as renewable natural gas (RNG) because the principal constituents are methane and carbon dioxide. NC's REPS program offers RECs for electricity generated from landfill gas and animal waste, including swine operations. In 2017, 5.9% of the State's RECs were from Landfill gas, and 3.6% were from animal waste.[24]

RNG can play an important role in reducing methane emissions, a potent GHG with global warming potential 25 times greater than carbon dioxide. Reducing methane emissions can have a larger impact on the environment than other carbon reduction initiatives. The IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global GHG mitigation pathways identifies this resource as one of the primary energy pathways.[25]

Agriculture is NC's top industry, accounting for $91.8 billion of the $538 billion gross state product and 17% of the state's workforce. The agricultural community sees RNG production as a new "home-grown" industry with the potential to increase employment and revenue generation potential for rural and agricultural communities, create more advanced, sustainable waste management solutions and produce bioenergy that offsets GHG emissions.

For NC, the agriculture sector accounted for 7% of the State's 2017 gross GHG emissions and waste management operations (landfills and wastewater plants) accounted for 6%. Combined, emissions from

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[20] Depending on the type of tree, forests may take decades to draw the same amount of carbon back out of the air.
[21] https://www.scientificamerican.com/article/congress-says-biomass-is-carbon-neutral-but-scientists-disagree/
[22] Department of Energy National Renewable Energy Laboratory, Energy Analysis: Biogas Potential in the United States, August 2013. https://www.nrel.gov/docs/fy14osti/60178.pdf
[23] Department of Energy and US Department of Agriculture concluded the Biogas Opportunities Roadmap http://www.usda.gov/oce/reports/energy/Biogas_Opportunities_Roadmap_8-1-14.pdf) in 2014, subtitled "Voluntary Actions to Reduce Methane Emissions and Increase Energy Independence."
[24] NC Renewable Energy Tracking System (NC-RETS), Feb 2019, https://www.ncrets.org/
[25] The Intergovernmental Panel on Climate Change, SPECIAL REPORT - Global Warming of 1.5 ºC, August 2018. https://www.ipcc.ch/sr15/

these activities equated to almost 40% of the total GHGs emitted from the State's electricity sector.[26] By 2030, emissions from the agriculture and waste management sectors are projected to be almost half of the total emissions from the electricity sector. RNG projects in the State have the potential to significantly reduce these emissions. Furthermore, RNG can reduce reliance on natural gas.

Stakeholders have expressed concerns over air and water pollution from swine operations' use of biogas technology that rely on lagoons and sprayfield waste management systems. Pollution to waterways, odors, and public health concerns for nearby and downstream communities, including those felt disproportionately by minority populations, are the reasons for opposition to biogas production.

States like California, Washington, Oregon and New York recognize RNG in meeting their GHG emission reduction goals. The private sector also incorporates biogas into their GHG mitigation plans. For example, UPS plans to convert 40% of their ground fleet to use alternative fuel, including RNG, by 2025. NC's agriculture to energy projects have been frontrunners in the country, and are pioneering the development and utilization of RNG. For example, Smithfield Foods plans to reduce its absolute GHG emissions by 25% by 2025, equivalent to 4 MMT. Smithfield Foods and Dominion Energy recently formed a joint venture Align Renewable Natural gas and are investing $250 million over the next decade to expand RNG on a wide scale. The City of Raleigh's Neuse River Resource Recovery Facility is incorporating an advanced anaerobic digestion process to reduce the overall biosolids content and accommodate future growth. The recovered RNG is planned to be used for the City's Go Raleigh bus fleet or sold to a third party as revenue, and is a key component of the City's GHG emission reduction strategy.

It is anticipated that over the coming years, new projects will be tested and applied at swine farms, food and solid waste operations, landfills and wastewater treatment plants. Technological advancements are expected to lead the industries to becoming cleaner and more efficient. The RNG industry is young and can help our state realize the benefits of decreased carbon emissions, improved resiliency (through alternative fuel supply and microgrid applications during disaster), less reliance on imported energy fuels or sources that are weather dependent, and economic development in the most impoverished areas of the state.

[26] NC Department of Environmental Quality, NC Greenhouse Gas Inventory (1990-203), January 2019. https://files.nc.gov/ncdeq/climate-change/ghg-inventory/GHG-Inventory-Report-FINAL.pdf

2. Drivers of Power Sector Transformation

The declining cost of clean energy and energy storage technologies, along with rapid advancement of information management, communications, and consumer products is transforming our electrical grid. These forces are leading the decarbonization of the electric power sector while creating economic development opportunities in urban and rural areas of the state. The four key drivers of power sector transformation in the 21st century are described below.

Key Drivers of Power Sector Transformation

- **Decentralization**
- **Digitization**
- **Decarbonization**
- **Development**

2.1 Decentralization Driven by Declining Costs

The costs of clean energy technologies have declined rapidly in the last decade. Lazard's latest annual Levelized Cost of Energy Analysis (LCOE 12.0) shows a continued decline in the cost of generating electricity from alternative energy technologies, especially utility-scale solar and wind. In some scenarios, alternative energy costs have decreased to the point that they are now at or below the marginal cost of conventional generation (see Figure 3). Lazard's data shows that since 2009, solar PV and wind costs have dropped 88% and 69%, respectively.[27] By 2024, Wood-Mackenzie predicts that wind energy will continue to cost less than new combined-cycle natural-gas facilities on an LCOE basis in 20 states, and will grow to 28 states by 2027. For battery storage, Lazard's latest annual Levelized Cost of Storage Analysis (LCOS 4.0) shows significant cost declines across most use cases and technologies, especially for shorter duration applications, such as utility-scale solar PV plus storage (see Figure 4).[28] Lazard also projects that by 2020, the cost of lithium-based storage could decline by 38%. An overview of key technologies enabling decentralization of the power grid is provided in the discussion below.

[27] "Lazard's Levelized Cost of Energy Analysis – Version 12.0", Nov 2018, accessed at https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf
[28] Ibid

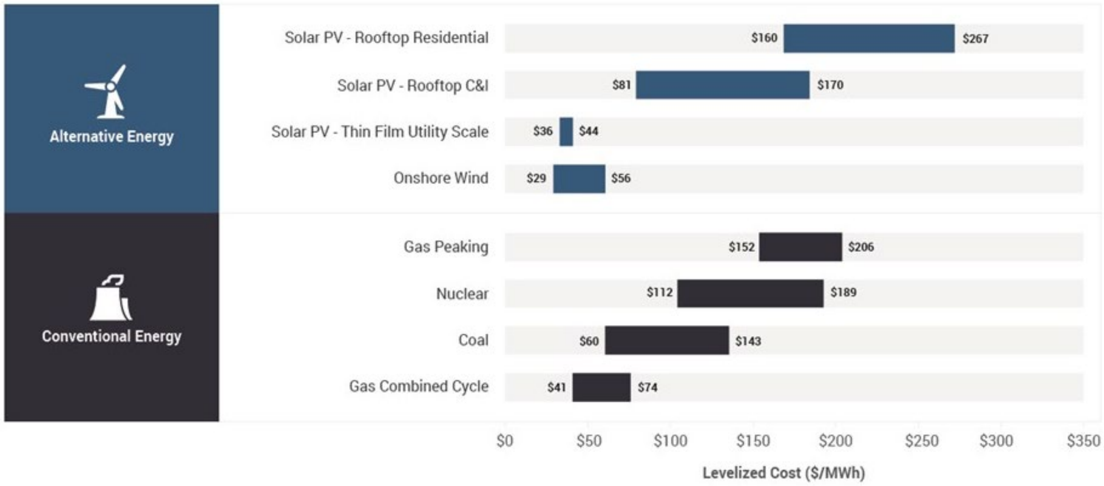

Figure 3: Lazard's Unsubsidized Levelized Cost of Energy for Alternative and Conventional Technologies, version 12.0

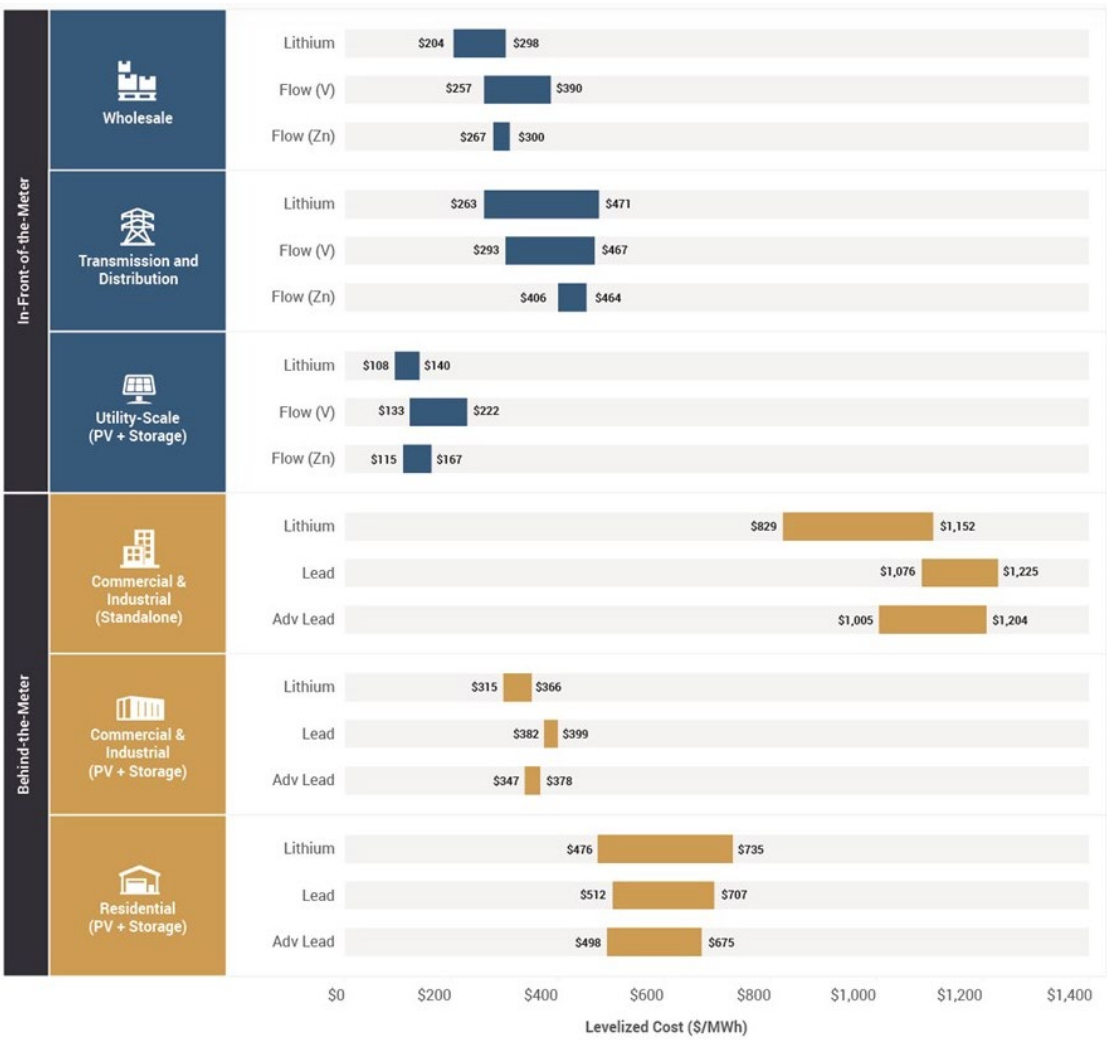

Figure 4: Lazard's annual Levelized Cost of Storage Analysis (LCOS 4.0)

2.1.1 Utility Scale Renewables

The Energy Information Administration (EIA) forecasts that non-hydroelectric renewables will be the fastest growing source of electricity generation. In April 2019, U.S. monthly electricity generation from renewable sources exceeded coal-fired generation for the first time.[29] Renewable sources provided 23% of total electricity generation, compared to coal's 20%. EIA's January 2019 Short-Term Energy Outlook (STEO) forecasts that electricity generation from utility-scale solar generating units will grow by 10% in 2019, and by 17% in 2020. Wind generation is predicted to grow by 12% and 14% during the next two years.[30]

This projected growth is a result of new generating capacity the industry expects to bring online. In 2017, renewables represented almost 50% of the new utility-scale electric generating capacity added to the U.S. power grid. Solar is the third-largest clean energy source in the U.S. power sector, having surpassed biomass in 2017. The U.S. electric power sector plans to add more than 4 GW of new solar capacity in 2019, and almost 6 GW in 2020, a total increase of 32% from the operational capacity at the end of 2018. There are now more than 2 million solar installations in the U.S., with an additional 2 million anticipated by 2023.[31] Figures 5 illustrates historical and projected solar capacity additions for the US.

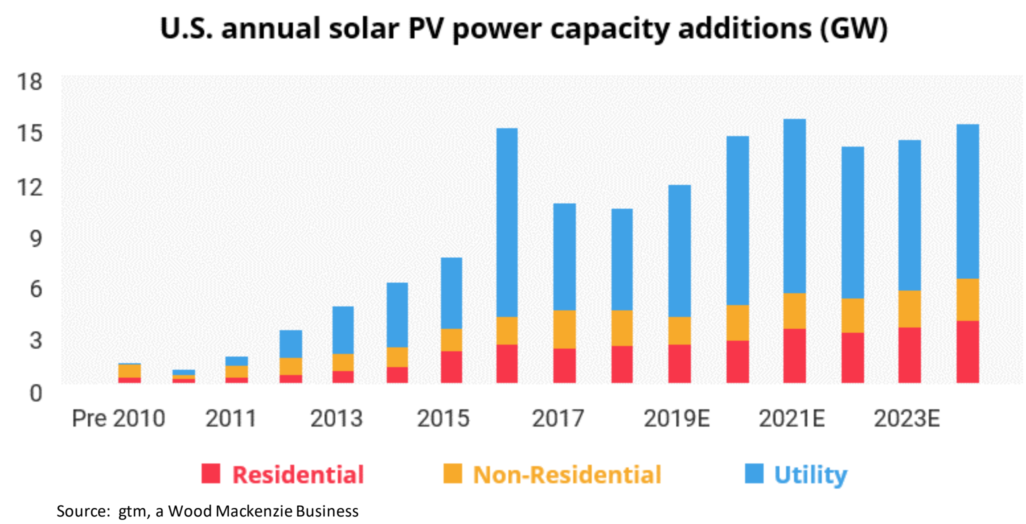

Figure 5: Solar Photovoltaic (PV) Capacity Additions

According to the Solar Energy Industries Association, NC is currently ranked 2nd in the nation for cumulative total installed solar capacity. Figure 6 (next page) shows the rise and leveling off of solar installations in the state, with utility scale projects dominating the capacity growth. How the utilities comply with HB 589, taking into consideration grid operational needs, customer demands, and cost, will determine the level of solar capacity added in the coming years.

[29] U.S. Energy Information Administration, Electric Power Monthly
[30] U.S. Energy Information Administration, Current Issues and Trends. https://www.eia.gov/electricity/issuestrends/
[31] https://www.greentechmedia.com/articles/read/how-distributed-energy-is-reshaping-the-energy-landscape#gs.r0dwgu

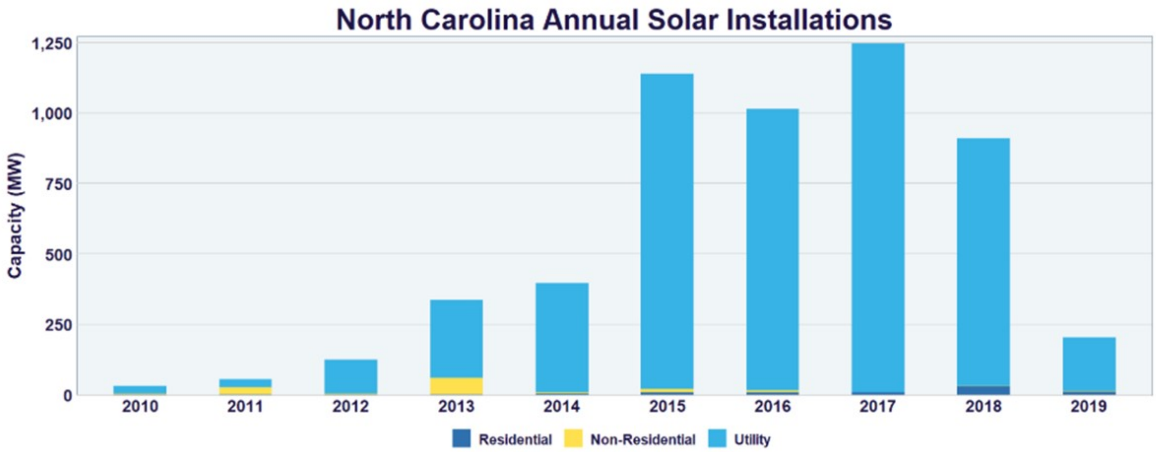

Figure 6: NC Annual Solar Installations [32]

Wind turbines now operate across 41 states and 2 U.S. territories. The U.S. wind industry installed 841 MW of new wind power capacity in the first quarter of 2019, a 107% increase over installations in the first quarter of 2018. It is estimated that through calendar year 2019, installed capacity for wind energy generation will grow, likely doubling the installations completed in 2018. This drastic expansion should continue for the next few years as developers install projects prior to the expiration of the Production Tax Credit.[33] The U.S. EIA predicts that wind capacity additions in 2019 will total 12.7 GW, exceeding annual capacity additions for the previous 6 years.[34] The long-term outlook for offshore wind (OSW) energy generation is similar – the U.S. Department of Energy (DOE) reports a total project pipeline of 25,434 MW as of June 2018, of which 3,892 MW is in project-specific capacity and 21,542 MW of undeveloped lease area potential capacity.[35] As of the date of this Report, only one utility-scale wind energy facility is in operation in NC; the 208 MW nameplate capacity Amazon Wind Farm near Elizabeth City.

The states of Virginia, Maryland, Massachusetts, New Jersey and New York are advancing offshore wind projects. In Virginia, Dominion Energy began construction of a two-turbine OSW as a demonstration project in the second quarter of 2019.[36] New Jersey selected a company in June 2019 through a request for proposal (RFP) to build a 1,100 MW wind farm off the coast of Atlantic City. In July 2019, New York

[32] NCSEA
[33] The PTC provides operators with a tax credit per kWh of renewable electricity generation for the first 10 years a facility is in operation.
[34] U.S. EIA. Tax Credit Phase Out Encourages More Wind Power Plants to be Added by End of Year. http://www.eia.gov/todayinenergy/detail.php?id=39472#. Accessed on May 17, 2019.
[35] 2017 DOE Offshore Wind Technology Market Update.
[36] Washington Post. Utility taking cautious approach as Virginia offshore wind project gets underway. July 1, 2019. https://www.washingtonpost.com/local/virginia-politics/utility-taking-cautious-approach-as-virginia-offshore-wind-project-gets-underway/2019/06/28/540493c6-99c3-11e9-916d-9c61607d8190_story.html?noredirect=on&utm_term=.ac52d8c0fb89. Accessed July 31, 2019.

State reached an agreement to build two large OSW projects off the coast of Long Island, the largest combined OSW contracts executed by any state to date, totaling 1,696 MW.[37,38]

2.1.2 Distributed Generation

Distributed generation represents electricity that is generated on the customer side of the electric meter or near the point of use instead of at central power plants. Examples of distributed renewables include small-scale solar systems, rooftop solar, and small wind turbines. EIA forecasts that small-scale solar generating capacity will grow by 44% between 2018 and 2020, or 9 GW. The increased deployment is partly due to the plummeting costs of distributed solar, with residential system prices dropping more than 60% since 2010. Additionally, advanced inverters (devices that convert the direct current that solar panels provide into the alternating current that flows on the power grid) are improving the performance and management of small-scale distributed generation by handling unanticipated grid conditions.

2.1.3 Energy Efficiency and Demand Response

Energy efficiency (EE) measures are technologies and processes that use less energy to perform the same function (e.g., energy-efficient lightbulbs and major appliances). Demand response activities are performed by customers to reduce electricity use at times of high-priced peak electricity consumption. Both of these demand side management approaches decrease the overall electricity demand from the grid, which in turn, avoids the cost of building new generation and transmission lines, saves customers money, and lowers pollution from electric generators. EIA's annual survey of electric utilities tracks the incremental annual electricity savings and costs from utility-run EE programs. Incremental energy savings are the additional energy savings from new participants in EE programs during the current reporting year. The amount of incremental energy saved through EE programs increased from 26.5 million MWh in 2014, to 29.9 million MWh in 2017. At the same time, incremental spending on EE programs has remained flat in recent years.

Demand response programs typically offer customers a rebate or lower energy costs for reducing energy use during specified hours or allowing the utility to cycle its air-conditioning systems when needed. These programs are increasingly being implemented through price signals and advanced software systems that can automatically reduce energy consumption across building fleets at periods of peak energy demand. However, since implementation of EE is a customer choice and not a requirement, the electricity system may not be able to fully rely on customer behaviors to reduce demand.

2.1.4 Battery Storage

Lithium ion batteries currently dominate the world of advanced energy storage. Other forms of storage technologies include compressed air, thermal storage, and pumped hydro storage. Energy storage systems reduce the need for peaker power plants, improve the resilience of the power grid, and can be paired with

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[37] New York Times. New York Awards Offshore Wind Contracts in Bid to Reduce Emissions. July 18, 2019. https://www.nytimes.com/2019/07/18/business/energy-environment/offshore-wind-farm-new-york.html. Accessed July 31, 2019.

[38] Utility Dive. New York awards record 1,700 MW offshore wind contracts. July 19, 2019. https://www.utilitydive.com/news/new-york-awards-record-1700-mw-offshore-wind-contracts/559091/. Accessed on July 31, 2019.

intermittent renewable generation systems to operate as virtual power plants. The use of utility-scale battery storage units (1 MW or greater power capacity) has grown in recent years. Operating utility-scale battery storage power capacity has more than quadrupled from the end of 2014 (214 MW) through March 2019 (899 MW). Assuming planned additions are completed and no existing operating capacity is retired, EIA predicts that utility-scale battery storage power capacity could exceed 2,500 MW by 2023 (see Figure 7). The total deployment of utility and non-utility energy storage is projected to reach 4,500 MW and represent a $4.8 billion market by 2024.[39]

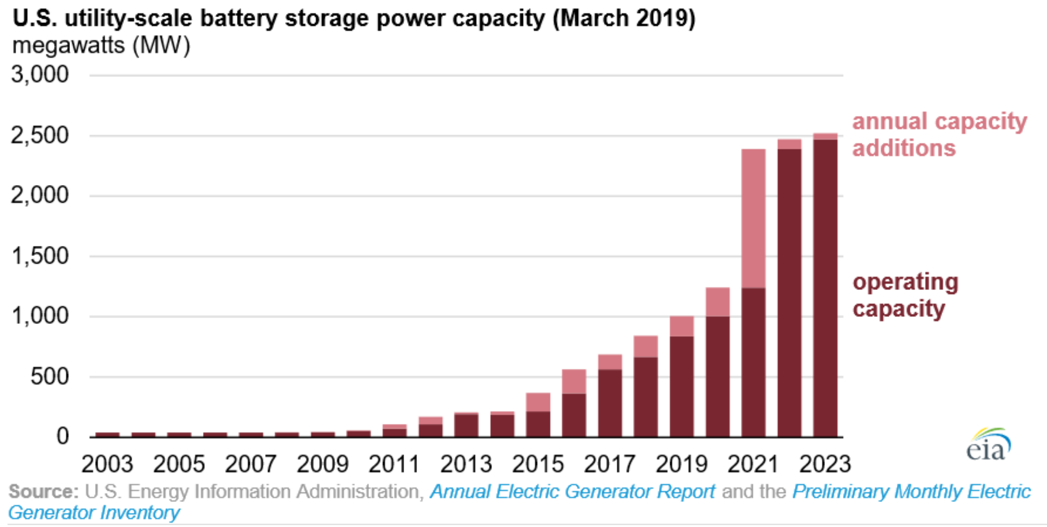

Figure 7: Battery Storage Capacity Additions

The growth in utility-scale battery installations is the result of supportive state-level energy storage policies and the Federal Energy Regulatory Commission's (FERC) Order 841 that directs power system operators to allow utility-scale battery systems to engage in wholesale energy, capacity, and ancillary services markets. Rapidly declining costs are also increasing deployment of these systems.

As of March 2019, the largest utility-scale battery storage sites operating in the US provide 40 MW of power capacity, and are located in Alaska and California. Based on the current inventory of battery storage projects planned for construction, EIA reports that a 409 MW facility in Parrish, Florida will start commercial operation in 2021. This project will be the largest solar-powered battery system in the world and will store energy from a nearby Florida Power and Light solar plant.

In NC, only about 1 MW of battery storage capacity has been installed as of 2018, however several battery projects are planned. The 2018 IRPs for Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) indicate that a combined total 291 MW of battery storage is expected to be installed by 2033. Cypress Creek, a large NC solar developer, plans 12 MWh of battery storage facilities coupled with solar for the Brunswick Electric Membership Corporation. As part of a community solar project, a 500 kW Li-ion battery combined with a 1 MW solar project is planned for the Fayetteville Public Works

[39] Wood Mackenzie P&R/ESA, U.S. energy storage monitor Q2 2019, https://www.woodmac.com/research/products/power-and-renewables/us-energy-storage-monitor/

Commission.[40] Duke Energy recently received approval for a solar PV plus storage project in Hot Springs by the NC Utilities Commission (NCUC). This project will include 2 MW of solar and a 4 MW battery and is intended to improve electric reliability in the town, which is on a constrained transmission line.[41]

NC does not have any programs specifically designed to facilitate energy storage installations. However, there are policies in place that have energy storage deployment implications. HB589 includes a number of PV deployment program goals for NC.[42] In addition, NCUC dockets implementing one of HB589 programs – Competitive Procurement of Renewable Energy (CPRE) – have topics relevant to energy storage. One docket in particular deals with energy storage protocol that is a part of the CPRE power purchase agreements. In docket hearings, it was noted that electric grid ancillary services, like frequency regulation and voltage control which are particularly suited to batteries, have no transparent market value in NC, making it difficult to monetize the value of these services for a developer considering installing battery storage.[43] Comments made by the NCUC Public Staff regarding the lack of energy storage market transparency state that market participants and Duke Energy generally agree that energy storage can provide many grid benefits, such as frequency regulation, operational reserves, and firm capacity; however, there is no mechanism to pay market participants for these services. Further review would be needed to determine how market participants can be compensated for those services, recognizing that they are bundled in the payment system that Duke Energy uses today. Although price declines will contribute to increasing energy storage in NC, policies may also be necessary to integrate energy storage onto the NC electric grid supporting a timely shift to clean energy.

2.1.5 Microgrids

Localized grids that can disconnect or "island off" from the utility power grid are called microgrids. Microgrids consist of distributed energy resources (DERs) and control systems that operate autonomously when called upon, increasing grid flexibility and resiliency.[44] The types of technologies used in microgrid applications include solar PV, battery storage, fossil fuel generators, fuel cells, combined heat and power systems and smart controls. There are roughly 160 microgrids with 1.6 GW of capacity operating in the US today, and capacity is estimated to reach 4.3 GW by 2020. According to the third quarter report, *U.S. Microgrids 2016: Market Drivers, Analysis and Forecast*, GTM sees US microgrid market opportunity doubling from $836 million in 2016, to $1.66 billion in 2020.[45]

Figure 8 shows the owners and application types of microgrid installations. The military is pursuing microgrids for energy security or to achieve RE goals, and is estimated to contribute to 52% of microgrid

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[40] NC State University, DeCarolis et al. (2018). *Energy Storage Options for NC.* p.4. Retrieved from https://energy.ncsu.edu/storage/wp-content/uploads/sites/2/2019/02/NC-Storage-Study-FINAL.pdf.

[41] Utility Dive. (2019). *NC approves Duke's first solar+storage residential microgrid.* Accessed at www.utilitydive.com/news/north-carolina-approves-dukes-first-solarstorage-residential-microgrid/554770/ .

[42] HB589 is discussed in the Clean Energy Plan section NC Energy Policy Landscape.

[43] NC Utilities Commission. May 1, 2019. Docket E-2 Sub 1159, E-7 Sub 1156 Hearing, p. 14.

[44] U.S. Department of Energy. (n.d.). The role of microgrids in helping to advance the nation's energy system. https://www.energy.gov/oe/activities/technology-development/grid-modernizationand-smart-grid/role-microgrids-helping

[45] US Mircrogrid Market Growing Faster than Previously Thought: New GTM Research, August 29, 2016, Elisa Wood, https://microgridknowledge.com/us-microgrid-market-gtm/

capacity deployed as of July 2019.[46] The second largest users of microgrids are data centers in commercial applications, representing 26% of capacity added to date.[47] Community microgrids are also on the rise, especially in the Northeast and Alaska, influenced by societal and environmental needs.

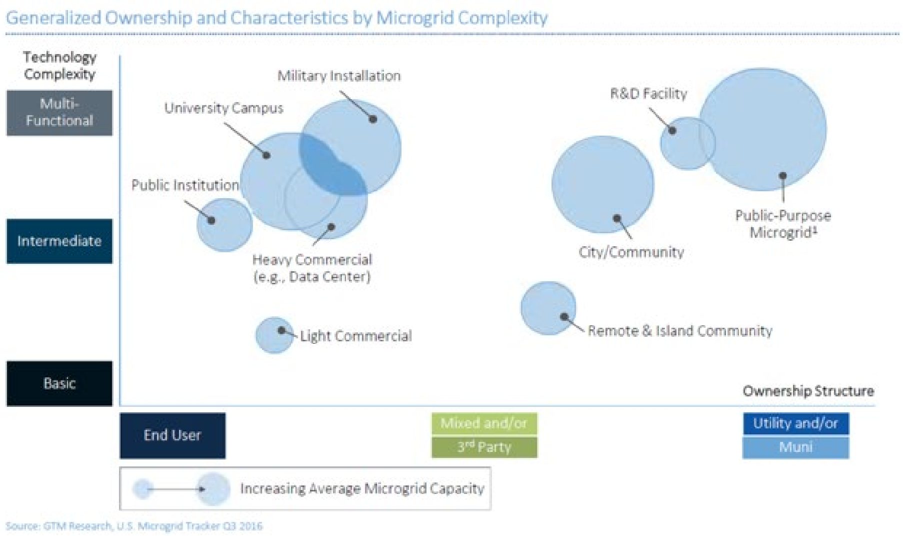

Figure 8: Microgrid Applications and Ownership Types

2.1.6 Electric Vehicles

The car industry is also undergoing a transformation, with almost every automaker planning to introduce more electric vehicle (EV) models and citing 2025 as the projected year when the upfront cost of an EV will reach parity with internal combustion engine (ICE) vehicles. In 2017, EVs represented 1.1% of new U.S. vehicle sales, or 200,000 vehicles. By 2025, J.P. Morgan estimates that EVs and hybrid EVs (HEVs) will account for an estimated 38% of all new vehicle sales (see Figure 9).[48] The U.S. DOE projects that by 2040, EVs could make up over 50% of new car sales, largely driven by plummeting battery costs.[49]

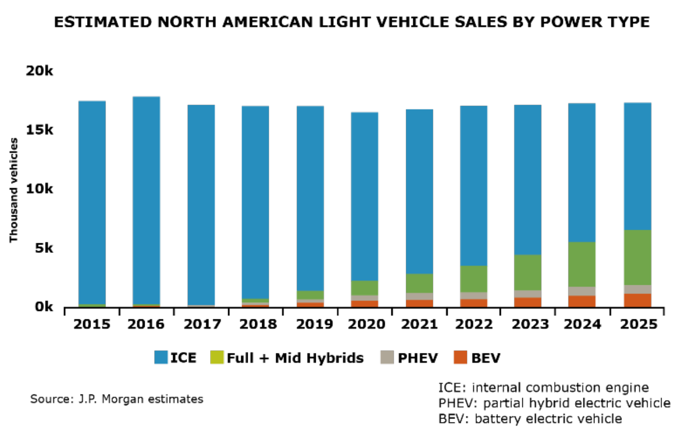

Figure 9: Projected Growth in Vehicle Sales

High rates of EV adoption present an opportunity to reduce GHG emissions, grow and smooth electricity demand, and cut fuel costs for consumers. However, there is growing concern that if not managed adequately, accelerated EV

[46] US Mircrogrid Market Growing Faster than Previously Thought: New GTM Research, August 29, 2016, Elisa Wood, https://microgridknowledge.com/us-microgrid-market-gtm/
[47] Ibid.
[48] Ibid
[49] U.S. Department of Energy. (2014). Evaluating electric vehicle charging impacts and customer charging behaviors—experiences from six smart grid investment grant projects. Retrieved from https://www.smartgrid.gov/files/B3_revised_master-12-17-2014_report.pdf

growth could significantly affect electricity usage and peak demand. Many states are exploring innovative planning approaches to deploy charging infrastructure and develop rates and utility business models to accommodate their residents' and business needs.

2.2 Digitization Driving Grid Operations and Grid Flexibility

With the continuous supply of smart devices and digital communications entering the market, a growing number of electricity customers are demonstrating interest in the ability to control their usage, control their bills and source their energy. Technology is enabling participation by customers through new capabilities and controls into homes, buildings, and end-use equipment. With the proliferation of electric devices, appliances, heat pumps, and EVs, customers can participate in a range of services by participating in smart charging programs or shifting their use to off-peak times. This increased use of technologies and DERs is moving from the traditional one-way system to one that is bi-directional and more complex. DERs are physical and virtual assets that are deployed across the distribution grid, typically close to load, and usually behind the meter. They include solar, energy storage, EE, combined heat and power (CHP/cogen), and demand management, and can be used individually or in aggregate to provide services to the electric grid.[50]

In a well-designed system, DERs can provide positive net value to the grid, such as avoided infrastructure investments, improved resilience, and increased integration of clean energy. Through these capabilities, customers can help mitigate or in certain cases, reduce electricity cost when they offer services to the utility. For example, customers who choose EE measures that shape their load to complement grid resource availability are contributing to keeping costs down for all customers because peaking loads contribute to grid infrastructure investment.[51]

At the heart of digitization and DER integration is distribution system planning (DSP). DSP is a process that identifies and characterizes areas of the grid that must adapt to changing technologies and markets, and serves as a valuable planning tool to guide utility investment, foster customer and marketplace activity, and provide value to the grid and the entire system. Utilities are already being asked to use DSP to reveal value opportunities on the system. NC's rural electric cooperatives have been early adopters of advanced technology, and are leading the way to increased reliability, two-way communication, load management, and grid operation. Service providers are also recognizing that new electric loads are flexible, and can be managed as grid resources by establishing the right price signals (e.g., customer choosing to use equipment during off-peak hours). However, since the use of DERs and EE are a customer choice and not a requirement, the electricity system may not be able to fully rely on these DER assets or behaviors to reduce demand.

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[50] Distributed Energy Resources 101: Required Reading for a Modern Grid, Advanced Energy Economy, February 2017, https://blog.aee.net/distributed-energy-resources-101-required-reading-for-a-modern-grid
[51] Trends in Technology and Policy with Implications for Utility Regulation, Regulatory Assistance Project, C. Linvill, J. Shernot and J. Shipley, April 2018.

2.2.1 Smart/Connected Devices

Homes and businesses are increasingly connecting devices and appliances to the internet or allowing them to communicate. This function allows for more frequent and user-specified control of the devices—resulting in greater system EE and demand response operation. Over the next few years, millions of new households are expected to install smart thermostats, smart light bulbs, and smart home controllers. Figure 10 illustrates the projected growth for three types of smart devices (connected lighting, smart thermostats, and voice assistant devices) between 2018 and 2023. The number of households with smart home devices is expected to more than double in the next two years.

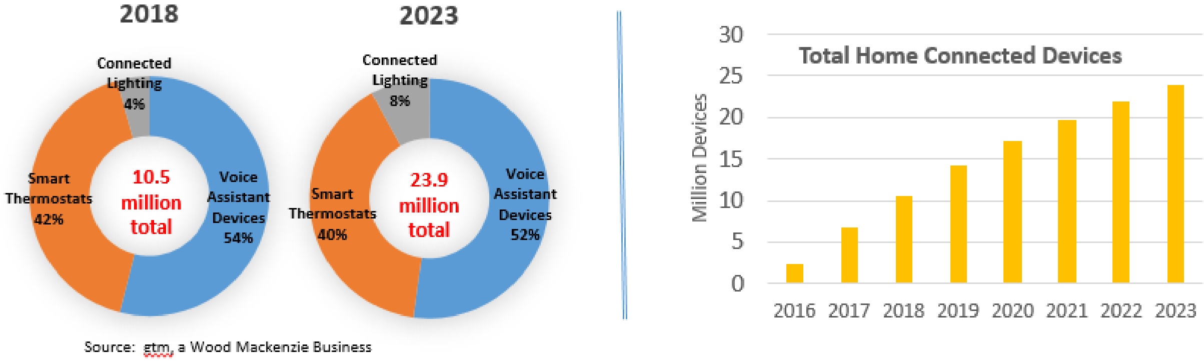

Figure 10: Projected Growth in Smart Home Devices

2.2.2 Smart Grid - Advanced Metering and Sensor Technologies

Throughout the country, advanced metering infrastructure (AMI) is enabling two-way communication between customers using smart devices and electric utilities (or third-party providers). AMI is an integrated system of smart meters and data-management systems. Transmission and distribution automation technologies are using data to change how electricity flows through the power grid, reshaping and modernizing the traditional grid. Figure 11 illustrates the AMI penetration levels for residential customers as of 2016. According to 2017 EIA data, 51% of NC residential customers have AMI, and an additional 30% have automated meter reading which provides one-way meter-to-utility data flow.[52] As a result of the trend towards a more customer-centric grid, NC utilities are implementing more AMI; the way these advanced technologies are transmitted, distributed, and managed accommodate the desire for two-way energy flow.

[52] EIA Annual Electric Power Industry Report, Form EIA-861 detailed data files, available from https://www.eia.gov/electricity/data/eia861/

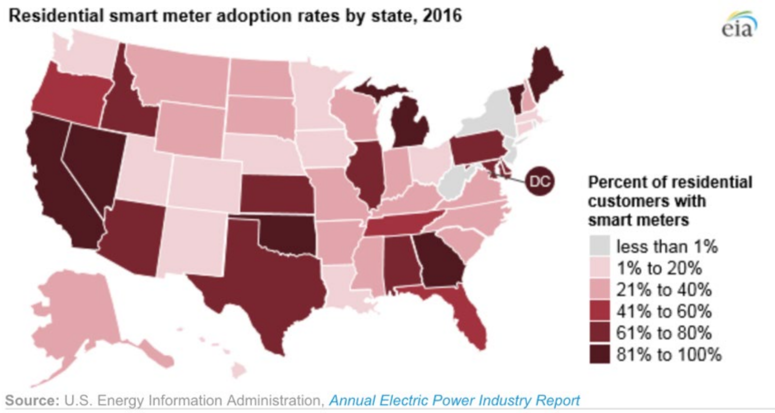

Figure 11: AMI Adoption Rates as of 2016

Advances in sensor technologies are enabling accurate, real-time conditions of the grid to be monitored, and are quickly becoming a fundamental component of the smart grid. Utilities employ sensors to monitor real-time two-way flow of electricity on the grid, improve reliability, provide real-time alerts about system disruptions, enhance responsiveness to outages, and support the integration of clean energy technologies.[53]

2.2.3 Big Data Systems and Communication Tools

Advanced meters, sensors, and devices operating on the power grid generate large amounts of digital data, many transmitting readings in small time intervals and requiring a significant volume of data storage capacity. As the number of smart devices increases, the data collection, management and interpretation of the modern grid will increase the role and value of big data and analytic software systems and services. The estimated economic growth opportunity in North America for this transition is estimated to triple from $390 million in 2016 to about $1.2 billion in 2025.[54]

Digital communication systems are providing the foundational infrastructure to support the technologies in a modernized grid. Advanced communication networks provide not only the capability to use the traditional electric power infrastructure to deliver data, but also enable utilities or grid operators to receive, interpret, and act on the data in near-real time. This flexibility enables assets across the grid to communicate with one another and respond to dynamic changes in electricity demand and supply.

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[53] U.S. Department of Energy. (n.d.). Synchrophasor applications in transmission systems. Retrieved from https://www.smartgrid.gov/recovery_act/program_impacts/applications_synchrophasor_technology.html; Southern California Edison. (n.d.). Remote fault indicators. https://www.edison.com/content/dam/eix/documents/innovation/RFIFactSheet-R2.pdf

[54] Utility analytics. Use cases, platforms, and services: Global market analysis and forecasts. (2016). Retrieved from Navigant Research website: https://www.navigantresearch.com/research/utility-analytics

2.3 Decarbonization Driven by Customer Desires

There is no doubt and scientific consensus supports the fact that GHGs emissions, which include carbon dioxide and methane, are contributing to global climate change. The effects of climate change pose significant risks to the communities, economies, and the environment. In the *2018 National Climate Assessment*, 13 federal agencies concluded that: (1) the most recent decade was the nation's warmest on record; (2) human activities, especially emissions of GHGs, are the dominant cause of the observed warming since the mid-20th century; (3) human-induced climate change is projected to continue and it will accelerate significantly if global GHG emissions continue to increase; and (4) the widespread and potentially irreversible impacts of a changing climate require an urgent effort to both reduce emissions and build resilient communities. North Carolinians understand that climate change is underway and are concerned about its impacts on current and future generations.[55]

The electric power sector is the leading emitter of GHGs in our state, contributing to about 35% of statewide emissions in 2017.[56] The power sector will continue to be NC's leading GHG emitter until about 2025, when transportation-related emissions are expected to surpass the power sector. NC's Clean Smokestacks Act, REPS, and market drivers have decarbonized the electric power sector at a faster pace than many other states. US power sector emissions have declined by 28% since 2005, due primarily to achievements in energy conservation, as well as switching among fossil fuels (coal to gas) and adding non-carbon sources.[57] According to the most recent statewide inventory, GHG emissions from the electric power sector have declined 34% relative to 2005 levels. It is estimated that with full implementation of HB589, the GHG emissions will decrease by about 50% by 2025, and remain at this level until 2030. To continue on the decarbonization path, many states have implemented market-based carbon reduction programs and/or adopted aggressive renewable energy and EE standards. Some states have established 100% renewable energy goals by 2040 or 2050.

Recognizing the urgency to take action to reduce GHGs and the desire to reduce power bills, North Carolinians are asking for more options to procure and deploy clean energy technologies and invest in EE measures. From rooftop solar to electric vehicle chargers, customers have more choices now than ever before – and this technology trend is projected to continue. The appetite for acquiring residential roof top solar continues to be unmet as evidenced by the recent sellout of the rebates within hours of being offered by Duke Energy as part of HB589 implementation.

Corporate priorities have also been driving increased customer demands. Today, 17 of the state's 30 largest private employers have set targets to procure more RE or reduce their energy consumption, and 37 companies doing business in NC have set a goal to be powered by 100% RE. These companies cross a wide range of industries, including major technology, service, and manufacturing companies. These businesses have moved beyond soft factors such as community relations and good publicity, and instead adopt fundamental strategic drivers to achieve their clean energy goals, including customer and

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[55] USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.
[56] NC Greenhouse Gas Inventory (1990-2030), January 2019, NC Department of Environmental Quality, deq.nc.gov/GHGinventory
[57] EIA Today in Energy, October 28, 2018. https://www.eia.gov/todayinenergy/detail.php?id=37392

shareholder demand, competitive advantage, attracting and retaining talent, operational efficiency, supply chain disruption, lower costs, and core values. For example, Apple is driving its entire supply chain to run on clean power, and announced that by 2020, it and 44 of its suppliers will generate or procure at least 5 GW of clean energy. In August 2019, Fifth Third Bank opened its 80 MW Aulander Holloman Solar Facility in eastern NC, adding to the company's announcement at the Nasdaq opening bell on March 7, 2018, to be the first Fortune 500 company to commit to purchase 100% solar power. Access to inexpensive, reliable, clean energy impacts decisions made by these companies about where they locate and expand, and whether they close existing facilities.

Many local governments across the State are setting environmental goals based on the interests of their constituents. In 2018, Asheville passed a resolution to transition municipal operations to 100% renewable energy by 2030. The Charlotte City Council unanimously passed a low-carbon resolution in 2018, and approved a Strategic Energy Action Plan to achieve it. In 2019, the city of Raleigh adopted a community-wide goal to reduce GHG emissions 80% by 2050, and began preparing an action plan to support this goal. Over 30 municipalities in the state have made public commitments to GHG reduction goals and/or clean energy targets. Local governments are motivated to reduce their carbon emissions because they see how infrastructure is suffering from being repeatedly battered and flooded during climate change-intensified hurricanes. They see how bad air and water quality is triggering health conditions in their jurisdictions. They also see how transitioning to a clean energy can provide a much-needed economic boost in their areas. Clean energy jobs in NC have been growing at nearly twice the state average and employ veterans at nearly twice the economy-wide rate. There is great interest in the manufacturing industry, as components of wind turbines and solar panels are constructed in NC. Cities see how electrifying our vehicles creates opportunity by supporting new business ventures for EV charging stations and ancillary infrastructure, while also improving local air quality.

Low-income and energy-burdened customers and communities are not able to take advantage of existing programs for clean energy or EE due to up-front costs and financing challenges, physical challenges related to the quality of the building or ownership status of their housing, or simply a lack of access to high-integrity service providers. Energy burdened communities are paying a disproportionately high amount of their income on energy bills and simply struggle to pay unaffordable energy bills. For those living with incomes below 50% of the federal poverty level (FPL), 33% of their annual income is spent on energy bills (energy burden), of which about 20% goes to pay electric bills. Many of the energy burdened communities are directly impacted by the health and pollution impacts resulting from energy production, generation, transportation. These compounding factors mean that these communities are the least able to reap benefits of investments in clean energy and EE while being most impacted by the legacy energy industry. Programs such as community solar and home weatherization offer some opportunities to directly reduce electric bill; however, public policy focusing on energy rates and an equitable and just transition to a clean energy economy is needed.

The agriculture community is also interested in responsible farmland management, creating solar energy benefits education and incentive program, and ensuring value to the farmer to optimize the use and sustainability of farms, forests, and solar production/decommissioning in NC. Significant potential exists to increase EE of agricultural operations and buildings, leading to reduced operating costs for NC's farmers.

2.4 Economic Development Driven by the New Energy Economy

NC has experienced rapid population increase (18.5% from 2000 to 2010, and an additional 10% from 2010-2018) and a large economic shift over the past 20 years from manufacturing towards a more service-oriented industry. These trends are likely to continue; the NC Department of Commerce projects that the service economy will contribute more than 90% of the new jobs in NC from 2017 to 2026.

As the electric power industry evolves from a highly centralized, capital-intensive industry to a more decentralized, distributed industry featuring independent power producers, rooftop solar installers, distributed clean energy aggregators, and other new businesses and business models, economic development can come from both jobs and investments that drive tax revenue in local communities.

NC is one of the 10 top states for clean energy jobs in the nation.[37] According to one of the most comprehensive national energy-related employment survey, NC had a total of 110,913 clean energy jobs in 2018 including solar (8,912), wind (908), clean vehicles (7,280), and EE (86,559).[38] Energy storage now represents 1,477 jobs in NC and "grid technology/other" claims 7,607 jobs (note some overlap in total numbers).[39] Reflecting national trends, the majority of NC's clean energy jobs are in construction (44%) followed by professional services including education and consulting (21%) and manufacturing (17% of total jobs).[40] Meanwhile, the NC Department of Commerce estimates that nearly 300,000 people in NC currently work in related clean economy industries, including clean energy generation, EE, and clean transportation. While not all of the industries in the Commerce study are 100% "clean," these industries employ the workforce needed to transition to a clean economy and employ workers in a wide range of occupations, with jobs available at all education, skill, and wage levels.[41]

While jobs are important to all communities, the revenues generated by clean energy investments and infrastructure projects can have even longer lasting benefits in both rural and urban counties. New RE projects and facilities can create ongoing revenue streams in their local communities.

Additional revenue can also be generated from exports. More than 20% of the clean energy goods and services generated in NC are exported to other states or nations, bringing new revenue into our state. Firms engaged in clean energy product manufacturing or production lead out of state exports, with approximately 53% going to other markets.[58] Research and development activities also have a strong out-of-state presence, with 38% of work destined for broader markets.[59] Moreover, NC can reduce its energy imports through clean energy generation and locally-driven EE projects.

The total economic impact of clean energy development in NC is estimated at $28.2 billion over the period of 2007-2018 including direct impact of $14.8 billion investment in clean energy development (which includes labor costs) and secondary impacts of $14.5 billion which include $2.9 billion in energy

[58] NCSEA. (2016). 2016 Clean Energy Census. Retrieved from https://energync.org/wp-content/uploads/2017/03/NC_Clean_Energy_Industry_Census_2016.pdf
[59] Ibid

costs savings.[60] The cumulative contribution to NC's Gross State Product from 2007-2018 is $16.9 billion, including $1.4B tax revenue over this period.[61]

Going forward, employers in NC are projecting 5% growth in employment over the next twelve months, driven largely by 8.3% growth in the EE sector.[62] Through the CEP stakeholder engagement process and collaborative partnership efforts, businesses have expressed a number of factors they deem important to achieve robust growth of NC's clean energy economy, and the role that clean energy and clean transportation play in attracting talent and industry to the state. For example, the burgeoning OSW industry alone is expected to create a new supply chain that is estimated at approximately $70 billion by 2030.[63]

Business interest in clean energy aligns with the need for cost savings, return on investments, risk management, attracting talent, meeting shareholder and customer expectations, driving innovation and staying competitive.[64] Business leaders have called for increased investment in EE programs, increased customer access to clean energy, accelerated deployment of electric vehicles and advanced development of energy storage. These companies believe that NC can leverage these recommended actions to attract new investment to the state, spur innovation, save money for ratepayers, attract new businesses and create jobs in NC.[65]

These recommendations must be balanced with maintaining NC's attractive lower energy costs. The business sector is keen to preserve low energy rates to reduce the cost of doing business in NC, especially energy-intensive sectors such as manufacturing, as the state navigates the path towards a clean energy future.

Today many states are surpassing NC with more aggressive REPS, renewables adoption, EE policies, utility regulatory reforms, and investment activity The corporate drivers alongside the national rankings create an opportunity for NC to take new steps to sustain and grow the economic benefits that clean energy can afford, while continuing to attract businesses, talent and investment to the State.

[60] RTI. (2019). Economic Impact Analysis of Clean Energy Development in NC—2019 Update.
[61] Ibid.
[62] Wood Mackenzie/SEIA. (2019). U.S. Solar Market Insight Report, Q2 2019.
[63] Special Initiative on Offshore Wind. Supply Chain Contracting Forecast for U.S. Offshore Wind Power, http://www.ceoe.udel.edu/File%20Library/About/SIOW/SIOW-White-Paper---Supply-Chain-Contracting-Forecast-for-US-Offshore-Wind-Power-FINAL.pdf. Accessed on May 31, 2019.
[64] Ceres. (2019, April 2). Letter to Governor Cooper.
[65] Ibid

3. CEP Development: Stakeholder Process

In preparation of the plan, the Department of Environmental Quality (DEQ) created an open and inclusive process to engage stakeholders. DEQ sought their input to generate a series of policy recommendations that addresses the needs of NC communities. Participants included elected officials, private citizens, industry groups, utilities, technology developers, businesses, non-governmental organizations, and leaders of the academic and faith communities. All of them offered solutions and a shared vision for NC's energy future.

The public engagement process, carried out from February to July 2019, was comprised of four types of events, referred to as methods. Method 1 was a series of facilitated stakeholder workshops, which were day-long events attended by 60-80 experts and key stakeholders with a vested interest in clean energy. Method 2 involved more general public outreach, achieved through regional listening sessions. These events were half-day sessions intended to educate members of the public about the CEP development process and to receive feedback and comments. Method 3 involved combining CEP-related activities with existing venues or events to collect feedback. Method 4 was the online comment portal, where members of the public who were unable to attend any of the in-person events could respond to specific questions and submit general comments.

This section summarizes the outputs of the facilitated workshops and other engagement methods, and is structured around three central themes shown in Figure 12. The six facilitated workshops in Raleigh provided the structural framework for the CEP. The workshops were designed and executed based on successful energy planning activities conducted in other states. Technical support was provided by the internationally-recognized utility regulatory experts, Regulatory Assistance Project (RAP), and facilitation support was provided by the Rocky Mountain Institute (RMI). Each workshop was organized to obtain feedback on specific topics identified by the participants.

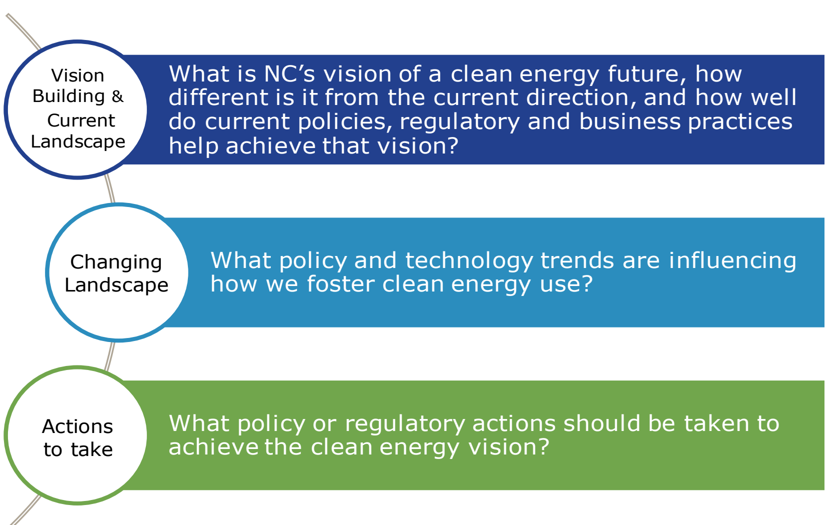

Figure 12: Facilitated Workshop Themes of Discussion

DEQ engaged with stakeholders from a variety of backgrounds and disciplines to understand their vision for NC's clean energy future. Throughout the series of workshops and public meetings, DEQ and participating stakeholders identified needs, issues, barriers, solutions, unrealized opportunities, equity concerns and required actions. Stakeholders and members of the public engaged in the process, which helped DEQ better understand their vision for a clean energy future in NC. Throughout the stakeholder and public engagement process, participants were given information about future energy demand, generation and supply strategies, and national trends in power grid modernization to help frame the discussion around issues relevant in NC. Rate impacts, economic and job opportunities, environmental and health impacts were also considered. The public engagement process culminated with stakeholders recommending and prioritizing policy, regulatory, administrative, local government, public, and business actions for achieving NC's clean energy future.

The draft CEP was released on August 16, 2019. The public comment period ran through September 9, 2019. DEQ received 660 comments, including 35 letters and 625 responses submitted through the online process. DEQ reviewed and evaluated all of the comments submitted and incorporated responses relevant to the goals of the CEP and priorities identified by the stakeholders.

3.1 Stakeholder Views on NC's Electricity System

During the 20th century, NC's electricity system consisted of large, centralized, fossil fuel-based plants that were owned and operated by electric utilities. During this period, strong growth in electric consumption necessitated the investments in continuously operating, large and long-lasting generating assets. The developing electricity system quickly became an essential service affecting the public interest. Under The Regulatory Compact, a single vertically integrated provider that owned and operated all three elements of the electricity system (generation, transmission, and distribution) was allowed to serve all consumers at lower cost with greater efficiency and reliability than multiple competing providers offering the same service. The result was a system of for-profit utilities operating in defined geographic service areas as protected monopolies, serving customers at a just and reasonable price that covered operating costs, plus a return on the capital invested in rates set by the NCUC. In return, the utility is required to serve anyone located within its service territory in a manner that is safe, reliable, and nondiscriminatory. The system allows the opportunity to recover reasonable operating costs and to earn a return on prudent capital investment, but not on operating costs. This arrangement has enabled build-out of generation capacity to meet peak-load demand, and a one-way flow of electricity from suppliers to customers.

75% of CEP stakeholders AGREED that NC's current electricity system is set up to achieve what it was intended to achieve in the last 100 years.

The 21st century electric grid is seeing declining load growth due to customer-enabled EE measures, demand response measures, a shift to less energy-intensive industries, and proliferation of behind the meter generation systems. The average annual growth in electricity consumption in the U.S. has declined from about 10% in the 1950s to less than 1% over the past decade. Data shows that economic growth indices have decoupled from the electricity generation sector at both state and national levels. This flexibility has opened doors for innovation, energy and environmental policy-making, greater customer choice, and new deployments in RE and DERs. Combined with declining technology prices and societal interests in addressing climate change, social equity and inclusion of underrepresented communities, the new electricity system is becoming much more transactional, bi-directional, and enabling customers to not only be recipients of services, but also suppliers of services to the grid.

66% of CEP stakeholders AGREED that NC's current electricity system can accommodate increasing levels

57% of CEP stakeholders DISAGREED that NC's current electricity system supports procurement of clean energy from a regulatory/utility

In this new era, the traditional electricity system is facing aging infrastructure, decline in utility revenue linked to generation investments and quantity of energy sales, growing demand for clean energy and data services, and reliability and resiliency concerns due to natural and physical threats such as weather related events and cyber-attacks. There is concern that the traditional regulatory framework will not continue to serve the public interest, could push consumer prices upward without a corresponding increase in value for customers, and potentially expose the State to excessive risk, costs and environmental damage.

Historically, NC has taken progressive and bold policy actions related to the electricity sector. As one of the first states in the nation to address air pollution from coal-fired power plants in 2002, NC enacted landmark legislation, the Clean Smokestacks Act, to cap emissions of nitrogen oxide and sulfur dioxide. The compliance strategy deployed by the affected utilities resulted in the closure of inefficient coal units and the operation of technologically advanced, well-controlled and most efficiently operated units in the nation. The legislation provided additional co-benefits such as decreased fine particulate emissions, carbon dioxide emissions, mercury emissions, and other hazardous air pollutants. In 2007, NC became the first state in the Southeast to enact a REPS.[66] Along with state and federal renewable energy tax credits, and favorable PURPA conditions, the REPS program propelled NC to become a solar industry leader, bringing associated jobs and economic development opportunity in rural areas of the state. In 2017, HB 589: Competitive Solutions for NC was enacted, which requires competitive procurement of renewable energy, creates a Green Source Advance program for large businesses, universities and the military to directly procure renewable energy, and creates a solar rebate and leasing programs program among other things.

[66] SB3

71% of CEP stakeholders DISAGREED that NC's current electricity system gives customers options for controlling energy use / source.

60% of CEP stakeholders DISAGREED that NC's current electricity system suitably addresses equity concerns.

Through these policy actions, the State has created a robust clean energy industry that continues to evolve. However, despite the planned reforms under HB589, uncertainty exists over increased investments in new natural gas facilities, how solar will be developed in the state going forward, unclear direction on the scope of large scale battery storage, wind generation, and electric vehicle programs, lack of options for rooftop solar, and concerns over inequitable access to clean energy, energy burden to low-income communities, and a just transition from traditional energy jobs. Customers are also raising questions about the power sector being the largest contributor of NC's GHG emissions and how much carbon reduction is technologically feasible while maintaining affordability and reliability.

The CEP stakeholders have communicated that the cost of electricity will continue to increase if nothing changes, while the current regulatory frameworks will inhibit the utility from pursing new technologies and limit the ability of third-party businesses from selling innovative technologies and services to customers. Furthermore, the stakeholders conveyed that a new regulatory framework can change the trajectory of costs by avoiding system costs and by forcing the utility to find more value from the electric distribution system and creating additional revenue streams from innovation and technology deployment.

3.2 Stakeholder Vision and Values to Uphold in a 21st Century Electricity System

Executive Order 80 (EO 80) and DEQ define clean energy resources to include solar, EE, battery storage, wind, efficient electrification, and other zero-emitting technology options capable of quickly decarbonizing the power sector and modernizing the electric power sector. The stakeholders involved in the public engagement process agreed with this direction, and outlined a vision aligned with this definition. The vision for NC's energy future is a clean, affordable, modern, resilient and efficient energy system, through the increased deployment of both grid scale and distributed energy resources, such as solar, EE, battery storage, wind, electrification, and other innovative solutions while giving customers more options and control, providing equitable access to clean energy opportunities, and helping customers reduce and control energy use at fair rates. In order to achieve a clean energy future that achieves this vision, NC's energy policy and regulations should work toward an integrated energy system that:

- Properly incentivizes the utilities, independent power producers, and consumers
- Recognizes the combined benefits of bidirectional flow of energy between the central grid and distributed energy resources
- Serves as a catalyst for innovation, new business development, and economic growth in the state
- Invests and retains capital in local communities, creates a 21st century workforce, and justly transitions to clean energy jobs
- Strengths out resiliency to natural threats and decarbonizes the electric power sector

In achieving this vision, the stakeholders prioritized the values to uphold and promote going forward, shown in Figure 13. Responses were submitted by 459 individuals across all engagement events, who were asked to rank their top three values from a list of 27. Participants emphasized community and social values in many comments and points of discussion during public engagement events, and stressed the need for a CEP that addresses decarbonization of the electricity sector. Among these stakeholders that represented business and industry groups, local government sector, private citizens, environmental groups, higher education, utilities, trade associations, and others, there was overwhelming consensus around the Environment and Carbon Reduction value, at 20%. It was ranked in the top three values in all submitted surveys from all events, and was prioritized by all sectors that were involved in the stakeholder process, including business groups, manufacturing, environmental organizations, educators, and members of the public. Affordability, Reliability, and Environmental Justice were also of high priority to participants, each at 7%.

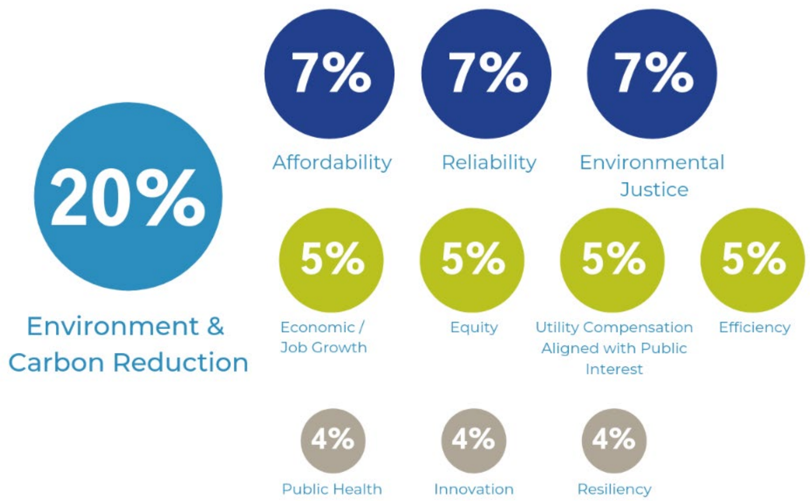

Figure 13: Stakeholder Voting Results on Values to Uphold in the Electricity System
459 respondents

To help achieve this vision and maintaining our core values, the stakeholder conveyed that NC should work toward an integrated energy system that:

1. recognizes the combined benefits of the central grid and DERs,
2. invests and retains capital in local communities,
3. creates jobs of the 21st century, and
4. serves as a catalyst for innovation, new business development and continued economic development in the state.

Future energy policy and regulations should strengthen our resiliency to natural threats, quickly decarbonize the electric power sector, and properly incentivize utilities, independent power producers, and consumers to make this vision a reality.

4. Detailed Policy and Action Recommendations

The CEP examines a time horizon of about ten years, with an outlook to 2030. This period was selected because the availability of technologies and energy resources are generally well known, and market trends can be reasonably predictable. The uncertainty of forecasts increases greatly beyond ten years; it is recommended that a similar planning process be carried out in periodic intervals in the future (e.g., every 3-5 years) as new technologies are developed, cost information is updated, and results of past actions can be evaluated to chart potential paths to take in the future.

The CEP defines three goals to achieve, as shown in Figure 14 on the next page. Each of these goals is based on clean energy's ability to reduce GHG emissions, grow NC's economy, and foster long-term energy affordability. These goals will not be achieved overnight, nor through implementation of one or two actions; rather it will require a collection of actions to set us on a path of modernization that prepares our residents, governments, and businesses to be competitive, proactive, and responsible stewards of our environment.

The policies and action recommendations identified here are intended to provide policy-makers, regulatory bodies, local governments, higher education entities, and the private sector with a high-level implementation plan for achieving the long-term goals and performance measure targets listed below. The recommendations generally represent the collective input of stakeholders from a wide range of perspectives. When viewed collectively, these strategies should help develop a clear picture of the steps that can be taken to maximize the economic and environmental benefits of clean energy. Decision-makers should use these strategies to inform their policy agendas and their investments. In summary, the CEP serves as a playbook of viable energy policies, and a roadmap to where NC wants to go.

Three overarching recommendations, listed below, are considered critical to the transition to a 21st century regulatory model that incentivizes business decisions that benefit both the utilities and the public in creating an energy system that is clean, affordable, reliable, and equitable. These key recommendations are considered central to the transformational shift that is necessary to lay a new foundation for a clean energy future, and will also enable successful implementation of many other related recommendations identified in the CEP.

- Develop carbon reduction policy designs for accelerated retirement of uneconomic coal assets and other market-based and clean energy policy options *(Recommendations A-1 and B-3)*.
- Develop and implement policies and tools such as performance-based mechanisms, multi-year rate planning, and revenue decoupling, that better align utility incentives with public interest, grid needs, and state policy *(Recommendations B-1 and B-2)*.
- Modernize the grid to support clean energy resource adoption, resilience, and other public interest outcomes *(Recommendations D-1, E-1, G-1, and I-1).*

NORTH CAROLINA CLEAN ENERGY PLAN
GOALS

Reduce electric power sector greenhouse gas emissions by 70% below 2005 levels by 2030 and attain carbon neutrality by 2050.

Foster long-term energy affordability for North Carolina's residents and businesses by modernizing regulatory and planning processes.

Accelerate clean energy innovation, development and deployment to create economic opportunities for both rural and urban areas of the state.

Figure 14: CEP Goals

The remaining portion of this section discusses recommendations organized into six strategy areas. For each strategy, the following information is provided: Background, Recommendation(s), Action(s) corresponding to each recommendation, implementing entity, and action schedule. The recommendations are grouped into six strategies shown in Figure 15 and summarized below.

- Carbon Reduction: focuses on the development of greenhouse gas mitigation policy designs for the electric power sector
- Utility Incentives and Comprehensive System Planning: addresses recommendations related to utility compensation methods, regulatory processes, and long-term utility system planning
- Grid Modernization and Resilience: identifies pathways to modernize the electric grid to support clean energy resources, and ways to establish and maintain grid resilience and flexibility
- Clean Energy Deployment and Economic Development: focuses on methods to increase customer access to clean energy resources, regulatory processes related to the way clean energy resources are valued, and emerging areas that can create economic opportunities
- Equitable Access and Just Transition: addresses methods to relieve the energy burden on low income communities, provide job training, and develop a clean energy workforce
- Energy Efficiency and Electrification Strategies: identifies approaches to electrify the transportation sector and end-use sectors

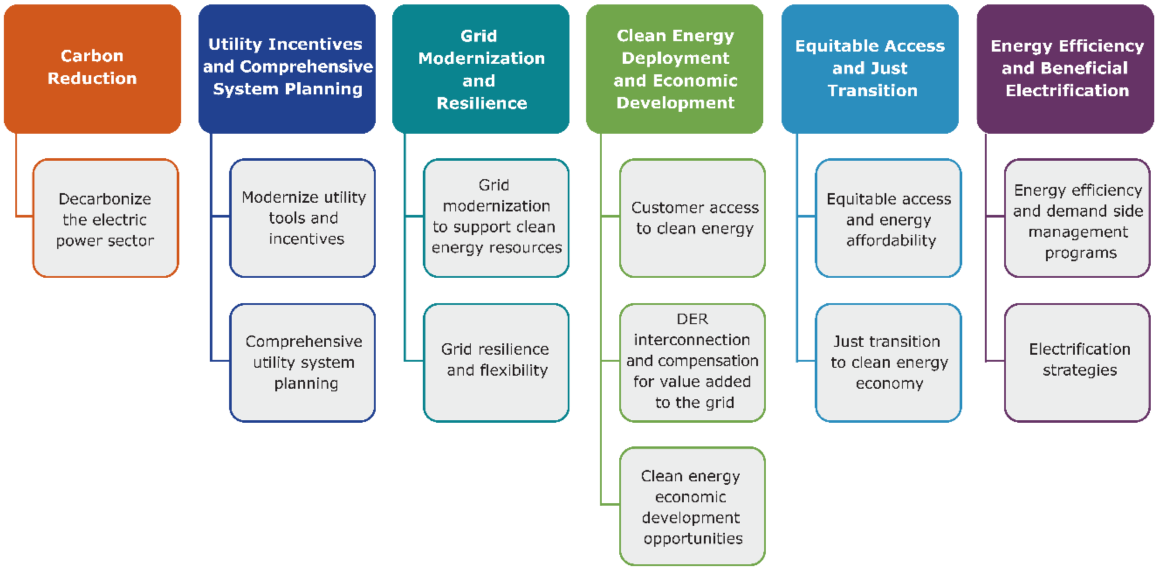

Figure 15: CEP Strategy Areas

The CEP presents short-term (less than 12 months), mid-term (1-3 years), and longer-term actions (3-5 years) to work towards the goals identified above. These time periods, shown in Figure 16, serve as indicators of priority items and activities that need to occur before related action(s) can take place.

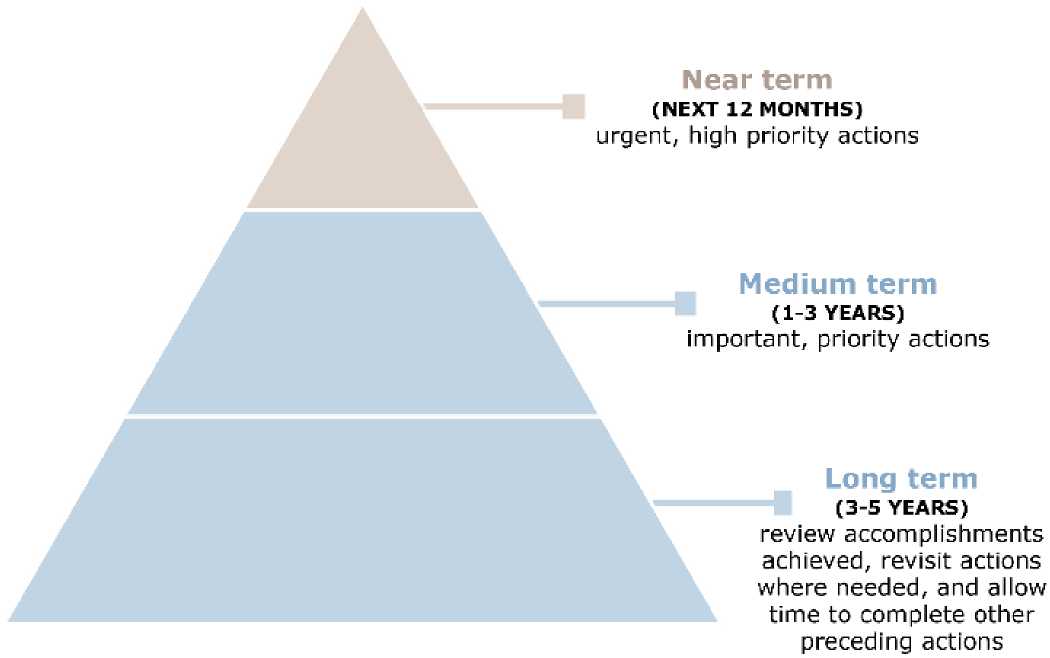

Figure 146: CEP Action Schedule

- Short term actions: considered essential to enable other positive outcomes to occur and are within the existing ability or authority of the implementing organization.
- Medium term actions: considered just as important but may take longer to initiate or implement.
- Long term actions: recognizes that it may take several years to take effect due to the level of complexity, difficulty or authority needed to implement. Some long-term actions also consider resources required for the implementing organization to carry out the activities.

Strategy Areas & Recommendations

4.1 Carbon Reduction

Carbon Reduction

A. Decarbonize the electric power sector

A-1

Deliver a report that recommends carbon-reduction policies and the specific design of such policies that best advance core values, such as GHG emission reductions, electricity affordability, and grid reliability. The report will evaluate policy designs for the following carbon reduction strategies:

1. Accelerated coal retirements,
2. Market-based carbon reduction program,
3. Clean energy policies, such as an updated REPS, clean energy standard, and EERS, and
4. A combination of these strategies.

A-2

Require integrated resource plans and distribution system plans to use portfolios and action plans that incorporate a cost of carbon into the portfolio or plan that is selected for use by the utility.

Strategy Area		Recommendation	Legislature	Utilities Commission	Governor's Office	State Agencies	IOU	CO-Ops / Public Utilities	Local Government	Academia	Businesses
Carbon Reduction	**A. Decarbonize the electric power sector**	A-1	•			•				•	
		A-2		•		•	•				

SHORT TERM

MEDIUM & LONG TERM

A. Decarbonize the electric power sector

Background and Rationale

NC's GHG emissions goal under EO 80 is to reduce emissions by 40% from all economic sectors by 2025. During the CEP public engagement process, NC stakeholders recommended setting an additional goal to "decarbonize" the electric power sector by 2050. While this goal is a steep challenge, many other US cities and states have set this same decarbonization target. In fact, several electric utilities have set this same goal.[67,68] Duke Energy currently has a goal of reducing CO_2 emissions from their electricity generation fleet by at least 50% from 2005 levels by the year 2030 and net-zero carbon emissions by 2050.[69] Duke Energy generates most of the electricity consumed in NC. Dominion Energy serves over 120,000 customers in northeastern NC, and has set a goal to reduce CO_2 emissions 80% by 2050 and methane emissions from natural gas assets 50% by 2030.[70]

NC has already reduced significant amounts of GHG emissions from the electric power sector. The State's Clean Smokestacks Act, REPS, PURPA and market drivers have decarbonized the electric power sector at a faster pace than many other states. According to the most recent statewide inventory, GHG emissions from the electric power sector have declined 34% relative to 2005 levels.[71] These reductions have been achieved in the absence of explicit carbon policies in the State. DEQ estimates that with full implementation of HB589, the GHG reduction level from the electric power sector will reach roughly 50% by 2025 and remain at this level out to 2030.

In order to further decarbonize the electricity generation sector as recommended by the CEP stakeholders, NC could choose (1) clean energy programs that remove uneconomical fossil generation and increase the use of cleaner energy resources, (2) carbon policy driven approaches that include targets for emission reductions and create a market for generating revenue, or (3) a hybrid approach that combines both clean energy and carbon policies.[72] Many states have proposed and implemented similar policies and programs that increase clean electricity generation while also reducing emissions of CO_2.

Table 4 shows the different approaches evaluated in support of the CEP. These approaches are based on the results of high level, predictive, electricity sector modeling exercises conducted by Resources for the Future, Georgetown Climate Center, Natural Resources Defense Council, and NC State University. DEQ conducted an analysis using the Eastern Regional Technical Advisory Committee's (ERTAC's) Electric Generating Unit Tool. These modeling exercises and analysis projected the impacts to the electricity

67 Xcel Energy. (2018). "Xcel Energy aims for zero-carbon electricity by 2050". December 4, 2018. Retrieved from https://www.xcelenergy.com/stateselector?stateSelected=true&goto=%2Fcompany%2Fmedia_room%2Fnews_releases%2Fxcel_energy_aims_for_zero-carbon_electricity_by_2050

68 Southern Co. (2018). "Planning for a low-carbon future". Southern Company. April 2018. Retrieved from https://www.southerncompany.com/content/dam/southern-company/pdf/corpresponsibility/Planning-for-a-low-carbon-future.pdf

69 https://news.duke-energy.com/releases/duke-energy-aims-to-achieve-net-zero-carbon-emissions-by-2050

70 Dominion Energy comment letter to DEQ on the draft Clean Energy Plan.

71 NC Greenhouse Gas Inventory (1990-2030), NC Department of Environmental Quality, Division of Air Quality, January 2019, accessed at https://deq.nc.gov/energy-climate/climate-change/greenhouse-gas-inventory.

sector from applying five different program and policy scenarios that reduce CO_2 emissions. The scenarios are described in Table 4.

Table 4: Policy Scenarios Modeled for the Electricity Sector

Scenario Name	Description
Accelerate Fossil Retirement	All coal power plants retire by 2030 and the generation shifts to non-emitting sources
Expand REPS or Clean Technology Standard	Requires a certain percentage of a utility's retail electricity sales must come from non- or low-emitting resources, energy efficiency, or demand side measures.
Market-Based Carbon Reduction Program	NC establishes a carbon reduction program that is linked with similar programs in other states and sets an initial CO_2 budget that declines each year by 3.0%.
Market-Based Carbon + Clean Tech	A linked market-based carbon program in a combination with a clean energy technology standard.

Part 5 of the CEP Supporting Documents, titled Energy and Emissions Modeling, discusses in detail the electricity sector modeling, the scenarios modeled, and the resulting impacts on the electricity sector. This includes 2030 CO_2 emissions estimates, electricity price impact (where available), and expected clean energy generation levels for each scenario identified above. Key highlights are discussed below.

Highlights from Electricity Sector Modeling

Modeling analyses seek to answer key questions for evaluating potential policy actions. Given assumptions about the future (e.g., costs of new technology, fuel prices, electricity demand), models first establish a reference or business-as-usual case that projects how the electricity sector would evolve in the absence of new policy. Will carbon emissions increase or decrease and by how much? What power plants are likely to serve electricity demand in the future and will new generation sources be required? Are existing power plants economical to retire? What share of the generation mix will be provided by each type of generation? What are the expected impacts on electricity prices? Reference cases are important because they provide a point of comparison for policy scenarios that project the impacts of new policy actions.

While a reference case gives policy makers and stakeholders a sense of the future electricity sector assuming least-cost decision-making, policy cases seek to identify the benefits and costs of new programs, policies or actions. The modeling efforts detailed in Part 5 examined three types of policy actions, alone or in combination:

1. Clean technology standard, renewable energy standard, or energy efficiency resource standard aimed at increasing the amount of electricity purchased and produced by specified technologies or increasing the amount of energy savings;
2. Carbon trading program limited to NC or linked to other similar state programs that make up the multistate Regional Greenhouse Gas Initiative (RGGI); and
3. A policy that requires coal retirements and requires replacement capacity to be met with renewables.

Each of the modeling organizations completed at least one reference case, and at least one policy case to help understand the potential benefits and costs of specific policy actions. While the models and modeled inputs vary across the different analyses, it is nevertheless possible to make some general, overarching observations:

- To achieve significant reductions beyond business as usual, the modeling suggests additional action will be needed. The modeling indicates that without additional policy action, NC's carbon emissions are likely to increase or decrease slightly by 2030, depending on the analysis.
- Emissions reductions can be achieved at low cost through a market-based carbon reduction program, especially when the program is linked to those in other states.
- Market-based carbon policies combined with policies to increase energy efficiency and renewable energy can further reduce carbon emissions and increase deployment of clean energy resources in NC.
- The particular design of new policies is important and has noticeable impacts on potential emissions reductions, wholesale and retail electricity cost impacts, capacity needs, generation mix, increase in clean energy resources, implementation costs, electricity imports, and economic benefits for the State.

Additional modeling analysis would help identify the particular policy designs of a market-based carbon reduction program and complementary policies--such as updating NC's REPS, establishing a clean energy standard, or passing an energy efficiency resource standard--to maximize benefits and minimize costs. Policy design includes elements such as level of stringency, parties covered by the policy, compliance timeline, mitigation of imported fossil generation, and strategies for investing any revenue generated.

NC Carbon Reduction Goal for the Electricity Sector

Based on the urgent need to reduce greenhouse gas emissions, quantitative and qualitative analyses, and stakeholder input, the CEP recommends an electricity-sector goal of 70% reduction in GHG emissions relative to 2005 levels by 2030 and carbon-neutral by 2050. In achieving this goal, NC's values such as electricity affordability, equity, and reliability should be fully considered.

Recommendations

A-1. Deliver a report that recommends carbon-reduction policies and the specific design of such policies that best advance core values, such as GHG emission reductions, electricity affordability, and grid reliability. The report will evaluate policy designs for the following carbon reduction strategies:

1. **Accelerated coal retirements,**
2. **Market-based carbon reduction program,**
3. **Clean energy policies, such as an updated REPS, clean energy standard, and EERS, and**
4. **A combination of these strategies.**

Based on current and projected operations of NC's power plants, emissions of CO_2 may decrease by 47% by 2030. Electricity sector modeling (summarized in Part 5 of this Clean Energy Plan) provided during development of the CEP indicates that NC will not reduce power sector greenhouse gas emissions 70% below 2005 levels by 2030 without new policies. New policies are needed to achieve the levels of greenhouse gas emissions required to meet this goal and a carbon-neutral power sector by 2050. The policy design of carbon-reduction policies is critical to achieving outcomes consistent with the core values of a significant and timely decline in greenhouse gas emissions, affordable electricity rates, expanded clean energy resources, compliance flexibility, equity, and grid reliability.

Identifying the policy design of potential carbon and clean energy policies for NC involves consideration of the following, informed by modeling as well as stakeholder input and analysis: projected impacts on emission reductions of carbon dioxide and other pollutants, monitoring and record keeping requirements, wholesale and retail prices, grid reliability, compliance flexibility, shifts in generation between fossil fuel, clean energy and imports, equity, compatibility with federal regulatory requirements, legal authority, and timeline for implementing the strategies identified.

In addition to the design elements discussed above, the individual policies have unique design elements that should be addressed as discussed below.

An accelerated coal retirement policy design must consider uneconomical fossil fuel resources, incremental benefits of retirement compared other options, whole sale and retail rate impacts, planned lifespan of fossil resources at issue, cost-recovery associated with early retirements, economic and environmental impacts of replacement energy resources, effects on electricity imports and exports, and requirements for approval of new fossil fuel units. The elements of this policy should consider the NCUC Order of August 27, 2019 (described below) and outcomes from recommendations B-1 and B-3 that examines utility financing tools to accelerate retirement of uneconomic generation assets.

Key policy design elements for a market-based carbon reduction program include level of emission limit, the scope of covered sources, distribution of emission allowances, investment of revenue generated from the program, linking the program with similar programs in other states, technical platforms for administering the program, and mechanisms for protecting ratepayers.

Clean energy policy design elements for complementary policies include the type of applicable technologies, the level of adoption required, compliance flexibility, any incentives for particular technologies, compliance timelines, duration of the policy, and mechanisms for protecting ratepayers.

On August 27, 2019, the NCUC ordered DEC and DEP to conduct several different analyses related to its IRPs which must be submitted by November 4, 2019.[73] The first involves modeling of 2030 CO_2 reduction goals to be performed for their IRPs. Duke Energy is required to analyze carbon reduction strategies including, 1) the implementation plan that results from DEC and DEP's current CO_2 reduction goals, 2) modeling of the draft CEP reduction goal, and 3) a comparison with Duke's current plans for CO_2 emissions reductions to the Governor's EO 80 which states that "The State of NC will strive to accomplish the following by 2025: Reduce statewide GHG emissions to 40% below 2005 levels." The NCUC also ordered DEC and DEP to provide an analysis showing whether continuing to operate each of its coal plants is the least cost alternative compared to other supply side and demand side resource options or fulfills some other purpose. The order also requires a more thorough analysis in its IRPs related to the benefits of purchased power, alternative supply side resources, DSM and EE programs, batteries, and a comprehensive set of resource options and combinations of resource options. Considering the timing associated with this order, the policy design recommendations should fully consider the utility's submissions and related NCUC decisions when developing any policy designs.

Electricity sector modeling indicates that market-based carbon reduction programs, clean energy policies or a hybrid of both approaches are effective policies for achieving emission reductions in a low-cost manner as well as other core values for the electricity sector. The design of these policies is critical to their impact on emissions, generation, costs, equity, and other factors.

Table A-1: Actions for Recommendation A-1

Entity Responsible	Action	Timing (Short, medium, or long term)
DEQ / Academia	DEQ will enlist assistance from academic institutions to deliver a report to the Governor by December 31, 2020, that recommends carbon reduction policies and the specific design of those policies to best advance core values—including a significant and timely decline in greenhouse gas emissions, affordable electricity rates, expanded clean energy resources, compliance flexibility, equity, and grid reliability. The report will evaluate policy designs for the following: (1) accelerated coal retirements, (2) a market-based carbon reduction program, (3) clean energy policies such as an updated REPS, an EERS	Short term

[73] Order of August 27, 2019, "In the Matter of the Biennial Integrated Resource Plan and Related 2018 REPS Compliance Plans", NCUC Docket E-100, Sub 157

	and clean energy standard, and a (4) a combination of these policy options.	
Legislature/DEQ	Take legislative and regulatory action to implement the policy designs recommended in the above report.	Medium term

A-2. Require integrated resource plans and distribution system plans to use portfolios and action plans that incorporate a cost of carbon into the portfolio or plan that is selected for use by the utility.

Investor owned utilities in NC must submit an IRP on a regular basis. An IRP is a plan for meeting future electricity needs that reviews all available supply-side and demand-side options and shows how the resource portfolio for electricity generation, transmission and distribution is expected to evolve over a specified planning period, typically 15 years. The resource portfolio chosen for the plan must result in a least cost system. In other states, utilities have recently begun to develop distribution system plans. These plans examine how DERs, including EE, demand response, distributed generation, batteries, and electric vehicles, may impact the grid, including providing reliability and resiliency services.

The utility commissions of multiple states are now requiring the use of a carbon price, a social cost of carbon, or a zero emissions credit in order to facilitate a resource planning process that accounts for the global impact of GHG emissions from fossil fuel combustion. This type of approach allows market based decision making in the resource planning process. States using this type of approach include California, Minnesota, Washington, New York, Colorado, and Illinois. Each state has a different approach to estimating and including these costs.

On September 17, 2019, Duke Energy announced new goals of reducing carbon emissions from their electric generation fleet by 50% by 2030, and achieving "net-zero" carbon emissions by 2050. At the time that this Plan was finalized, the details of how the company's new goals would affect future resource plans and other actions taken by the company were not clear.[74]

In recent years, the IRPs submitted by Duke Energy Carolinas (DEC), Duke Energy Progress (DEP) and Dominion have included planning scenarios that contain a cost of carbon in response to proposed federal carbon regulations. Since June of 2014, the US EPA has been in the process of writing and finalizing regulations regarding CO_2 emissions from fossil fuel power plants. The current EPA methods have a very low social cost of carbon, ranging from $1 to $8 per ton. This low cost does not significantly impact the IRP process. When a carbon price of sufficient value is included in the planning process, low-emitting or zero-emitting resources are favored over higher emitting resources.

Duke Energy and Dominion are investing considerable amounts in the construction of new natural gas pipeline infrastructure. The cost of this infrastructure will be passed onto electricity ratepayers in NC. These costs are currently not accounted for in the IRP process. Also not accounted for are the costs of carbon emissions associated with the construction and use of the pipeline itself. The IRP process could be modified to include these costs in the costs for building natural gas power plants.

The base price and high price for CO_2 used in the 2018 IRPs for DEC and DEP are as follows:

- Base CO_2 Price – Intrastate CO_2 tax starting at $5/ton in 2025 and escalating at $3/ton annually that was applied to all carbon emissions ($20/ton in 2030).
- High CO_2 Price – Intrastate CO_2 tax starting at $5/ton in 2025 and escalating at $7/ton annually that was applied to all carbon emissions ($40/ton in 2030).

[74] https://news.duke-energy.com/releases/duke-energy-aims-to-achieve-net-zero-carbon-emissions-by-2050

The 2018 DEC and DEP IRPs present two base cases for planning; a carbon constraint resource portfolio and a no carbon constraint resource portfolio. While Duke Energy develops these two different resource portfolios, the NCUC requires a least-cost resource portfolio. The cost of carbon is not consistently incorporated into this least cost planning.

Table A-3: Actions for Recommendation A-3

Entity Responsible	Action	Timing (Short, medium, or long term)
NCUC and Duke Energy	1) Establish a method to monetize CO_2 emissions to meet a CO_2 emission reduction goal of 70% by 2030. Begin including this carbon cost in IRPs starting in 2020. 2) Require the use of carbon pricing in any selected resource or action plan starting in 2020. This is occasionally being done voluntarily; for example, in the 2018 IRP, DEC selected a preferred portfolio with a carbon price, but DEP did not. 3) Include any costs associated with building a natural gas pipeline that will be passed on to NC electricity rate payers by the electric utilities.	Short term
DEQ	Serve as technical resource to the NCUC regarding above activities.	Short term

Strategy Areas & Recommendations

4.2 Utility Incentives & Comprehensive System Planning

Utility Incentives & Comprehensive System Planning

B. Modernize utility tools & incentives

- B-1: Launch a North Carolina energy process with representatives from key stakeholder groups to design policies that align regulatory incentives and processes with 21st Century public policy goals, customer expectations, utility needs, and technology innovation.
- B-2: Encourage use of pilot programs or other methods for testing and evaluating components of a performance-based regulatory framework.
- B-3: When authorizing "securitization" as a utility financing tool, include uneconomic generation assets in the scope of what can be securitized.
- B-4: Initiate a study on the potential costs and benefits of different options to increase competition in the electricity generation, including but not limited to joining an existing wholesale market and allowing retail energy choice.

C. Comprehensive utility system planning

- C-1: Establish comprehensive utility system planning process that connects generation, transmission, and distribution planning in a holistic, iterative and transparent process that involves stakeholder input throughout, starting with a Commission-led investigation into desired elements of utility distribution system plans.
- C-2: Expand cost-benefit methodologies used to make decisions about resources and programs to include societal and environmental factors.
- C-3: Implement competitive procurement of resources by investor-owned utilities.

Strategy Area		Recommendation	Legislature	Utilities Commission	Governor's Office	State Agencies	IOU	CO-Ops / Public Utilities	Local Government	Academia	Businesses
Utility Incentives and Comprehensive System Planning	B. Modernize utility tools and incentives	B-1	•		•						
		B-2		•			•				
		B-3	•	•							
		B-4	•			•					
	C. Require comprehensive utility system planning processes	C-1		•		•	•	•	•	•	•
		C-2		•				•			
		C-3		•							

SHORT TERM   MEDIUM & LONG TERM

B. Modernize utility tools and incentives

Background and Rationale

The traditional utility regulatory model in the US effectively achieved many of the policy objectives it was meant to. The ability to raise low-cost capital allowed regulated IOUs to build out a nationwide electric grid, and the regulatory model in use for the past 100+ years has led to reliable, nearly universal service, at generally stable rates. However, new public policy priorities and emerging trends are forcing reconsideration of the utility's responsibilities, now expanding to include new expectations for environmental performance, carbon reduction, customer choice, resilience, equity, and adapting to (or enabling) sector-wide innovation, among others, while retaining long-standing responsibilities such as reliability and affordability. These new demands are highlighting the limitations of the traditional utility incentive methods, forcing the industry to rethink how regulations can be updated to achieve new policy goals, as well as meet evolving grid and customer needs.

In NC, as in many other states, the existing regulatory structure encourages utilities to sell more kilowatt-hours of electricity and to invest in utility-owned capital infrastructure. These incentives do not necessarily lead to the least-cost and highest-value solution for customers. For example, distributed technologies now have the potential to substitute for conventional utility infrastructure solutions, but the current utility business incentive structure discourages utilities from selecting those options even if it would save customers money. The combination of declining load growth in the state,[75] significant cost declines for distributed resources, and necessary upgrades to system infrastructure is putting increasing strain on the current utility business. The state's utilities need a way to maintain their financial health and ability to access low-cost capital in a future where customers have growing options to reduce energy use, shift to on-site energy production, and are demanding more control over where their energy comes from. For example, in recent years the cost of clean energy has fallen so much that there is now evidence that existing utility coal assets in NC are no longer economic, meaning that customers would actually save money if the utility was able to accelerate the closure of those units and invest in renewable generation to meet demand instead.[76]

These trends are not unique to NC. A growing number of states are investigating the appropriate steps to take to move toward a regulatory model that better aligns utility profit-making incentives with societal objectives and removes the bias toward capital investments.[77] Revisiting how a utility earns revenues is a foundational step that can impact the successful implementation of all other strategy areas in this report. Indeed, many stakeholders in the CEP process identified the successful implementation of actions in this strategy area as enabling most of the other recommendations in the Plan.

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[75] The NC Utilities Commission reported that between 2016 and 2017, electricity sales from the State's three investor owned utilities declined by 2.7% while the growth rate of new customers increased by 0.34 – 1.57%. NC Utilities Commission, Major Activities Through December 2018 With Statistical And Analytical Data Through 2017, Volume XLIX, 2018 Report.

[76] Gimon, Eric, et al. *The Coal Cost Crossover: Economic Viability of Existing Coal Compared to New Local Wind and Solar Resources*, Energy Innovation and Vibrant Clean Energy, March 2019. Available at: https://energyinnovation.org/wp-content/uploads/2019/03/Coal-Cost-Crossover_Energy-Innovation_VCE_FINAL.pdf

[77] States include Hawaii, Minnesota, New York, Illinois, Rhode Island, Colorado, and Nevada.

Recommendations

B-1. Launch a NC energy process with representatives from key stakeholder groups to design policies that align regulatory incentives and processes with 21st Century public policy goals, customer expectations, utility needs, and technology innovation.

Updating NC's energy regulatory framework for 21st Century public policy goals, customer expectations, utility needs, and technology innovation will help the state realize its clean energy future. NC faces challenges on issues such as regulatory incentives, integration of distributed generation, transparent and efficiency regulatory processes, and holistic resource planning. Through the course of meetings and conversations for development of this Clean Energy Plan, some stakeholders called for an ongoing process outside traditional legislative and energy regulatory forums to work through large energy policy topics.

This energy process can involve an ongoing series of meetings among representatives of key stakeholder groups to find common ground on transformative energy-related topics. Through this process, stakeholders can tackle pressing issues by identifying shared principles and priority action areas and then working together to develop specific policy recommendations for delivery to the NC General Assembly, NC Utilities Commission, and other bodies, as appropriate. The group should address performance-based ratemaking as an action area and develop specific objectives and implementation recommendations for a new outcome-driven regulatory framework in NC. Under this action area, multi-year rate planning,[78] performance incentive mechanisms,[79] revenue decoupling,[80] shared savings mechanisms,[81] and retirement of uneconomic generation assets[82] should be addressed.

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[78] Multi-year rate plans (MYRP) fix the time between utility rate cases and compensate utilities based on forecasted efficient expenditures or external market factors rather than historical costs of service. Multi-year rate plans use an attrition relief mechanism (ARM) to provide timely, predictable rate escalation during the period between rate cases. This escalation is based on cost forecasts, industry cost trends or both, rather than the utility's specific costs. MYRP are an effective tool at incentivizing utilities to control costs between rate cases and have been used successfully by a variety of jurisdictions. See citation below for examples. While MYRP can be implemented in isolation, they are often paired with performance incentive mechanisms, which can help ensure that undesirable outcomes are avoided (e.g., utilities cutting costs that are actually beneficial to ratepayers in an effort to increase profits) and that desirable outcomes are achieved (e.g., reduced interconnection time, carbon emissions reductions, etc.). See Lowry, Mark, et al. State Performance-Based Regulation Using Multiyear Rate Plans for U.S. Electric Utilities, Lawrence Berkeley National Laboratory. July 2017.

[79] Performance incentive mechanisms create a financial incentive for a utility to achieve performance outcomes and targets consistent with customer and public policy interests.

[80] Revenue decoupling breaks the link between the amount of energy a utility delivers to customers and the revenues it collects. Decoupling mechanisms help to remove the utility's current incentive to sell more energy in order to increase revenue by making adjustments based on actual sales to ensure that the utility earns its revenue requirement.

[81] Shared savings mechanisms reward the utility for reducing expenditures from a baseline or projection by allowing the utility to retain some of the savings as profit, while passing some savings to consumers.

[82] Tools to accelerate retirement of uneconomic generation assets adjust rates to speed up the depreciation of an asset so the utility and its customers are not left with stranded costs when an asset retires early; securitization can refinance uneconomic utility-owned assets by creating a debt security or bond to pay down an early-retiring plant's

Additional priority action areas may include energy sector planning, regulatory processes, and customer options around clean energy generation and energy savings. Additional priority action areas may include energy sector planning, regulatory processes, and customer options around clean energy generation and energy savings.

The energy process can be facilitated by an objective third-party with extensive experience in the energy sector, involvement with similar processes in other states, and an understanding of NC's energy sector. To develop recommendations with broad buy-in, the process can include representatives from various stakeholder groups and produce work products for public input before submission to the applicable body.

Table B-1: Actions for Recommendation B-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Governor's Office	Convene an energy process to align energy regulatory incentives with 21st Century public policy goals, customer expectations, utility needs, and technology innovation, by addressing topics such as performance-based ratemaking, multi-year rate planning, and revenue decoupling.	Short term
Legislature	Implement legislation recommended by the stakeholder process.	Short to medium term

undepreciated capital balance. There are potentially multiple ways to define "uneconomic" and a decision to pursue retirement of utility assets will need to be closely analyzed by the NCUC. For purposes of the discussion in this report, uneconomic assets are those that could have their output replaced by other resources (or a combination of resources) at an all-in cost that is lower than the existing resource's current costs (both capital and operating costs). That is, ceasing operation of an existing power plant and replacing it with another resource would result in lower costs and risks to ratepayers.

B-2. Encourage use of pilot programs or other methods for testing and evaluating components of a performance-based regulatory framework.

Shifting to a more performance-based regulatory framework will require some extent of flexibility. Depending on the outputs that result from the investigatory process described in the prior recommendation, pilot programs and phased approaches to policy implementation provide opportunities to test and refine specific regulatory mechanisms, such as performance incentive mechanisms and new procurement practices. In order to be adaptive, there should be processes for evaluation built in to ensure new mechanisms are working as intended. Performance metrics that measure and track utility data for certain outcomes are a key, no-regrets tool to ensure that utility performance is improving after implementing a given regulatory change. For example, testing a shared savings mechanism before full-scale implementation will provide an opportunity to ensure that the savings retained by the utility and given to customers are well-balanced. Alternatively, using a phased approach to the development of new performance incentive mechanisms could result in better informed targets and incentive levels that don't under- or over-compensate the utility.

Table B-2: Action for Recommendation B-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Require utilities to design pilots or other phased approaches to testing regulatory mechanisms that result from investigatory process on utility business model reform*	Medium term
IOUs	Co-develop pilot proposals or phased implementation approaches to test new regulatory mechanisms with NCUC and stakeholders	Medium term

*Depending on the approaches recommended by the stakeholder process, the NCUC may need to be given explicit authority by the legislature to pursue this recommendation.

B-3. When authorizing "securitization" as a utility financing tool, include uneconomic generation assets in the scope of what can be securitized

As of the writing of the Clean Energy Plan, pending legislation (Senate Bill 559), would create a new financing tool known as securitization that may be used to recover storm restoration costs. Using this financing tool, the utility could issue storm recovery bonds with lower financing costs that are secured through a dedicated storm recovery charge that is separate and distinct from the utility's base rate. Securitization typically benefits utilities and customers. Utilities benefit because they receive an immediate source of cash from the bond proceeds and customers benefit because the cost of securitized debt is lower than the utility's cost of debt, which reduces the impact on their monthly bills.

As described in the recommendation above, states are allowing securitization to be used to accelerate the retirement of uneconomic generation assets.[83] Instead of issuing storm recovery bonds, a bond that is equal to a retired plant's undepreciated capital balance would be sold to the public market. Proceeds from bond sales could then be invested in clean energy projects that still earn a return for the utility or invested in assistance for communities' transitioning away from generating fossil fuels.

Stakeholders in the Clean Energy Plan process identified securitization as an effective tool to help the state meet the carbon reduction goals included in this plan. Any legislation allowing securitization to be used as a financial tool by the utility should therefore include generation assets as eligible for cost recovery and require utilities to use freed-up capital to invest in clean energy. Legislation should direct NCUC to initiate a rulemaking to determine securitization details, such as:

- Requirements for utility applications and approval
- Which utility costs should be able to be recovered by securitization bonds
- How certain percentages of freed-up capital should be spent, subject to legislative direction regarding investments in clean energy
- Restrictions on bond terms (e.g.,15–20 year term length, 3% interest rate)

Table B-3: Action for Recommendation B-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature	Expand scope of costs eligible for securitization in legislation to include uneconomic generation assets; direct NCUC to initiate and oversee proceeding focused on the uses of securitization	Short term
NCUC	Initiate and oversee rulemaking to determine details of securitization use cases	Short term

[83] States include Colorado, New Mexico, Michigan, Wisconsin, and Montana.

B-4. Initiate a study on the potential costs and benefits of different options to increase competition in the electricity sector, including but not limited to joining an existing wholesale market and allowing retail energy choice.

Since the 1990s, states across the country have been looking at ways that greater competition in electricity generation can provide customers more reliable energy at lower costs. This has led to the emergence of competitive wholesale and retail markets in several regions, sometimes referred to as the movement toward "restructured" or "deregulated" markets. Wholesale markets can be found in Texas, California, the Mid-Atlantic, parts of the Midwest, and the Northeast, covering approximately two-thirds of the US population. At the retail level, thirteen states and the District of Columbia have implemented some form of electricity consumer choice.

However, states do not necessarily need to have both competitive wholesale and retail electricity markets. A number of states that are part of restructured wholesale markets do not have full retail access, such as Kansas, Oklahoma, and Minnesota. It is also possible for states to have retail electricity choice but not participate in a wholesale electricity market. For example, Georgia and Oregon both have retail electricity choice for large commercial and industrial consumers, but those states are not part of any restructured wholesale power market.[84]

In the 1990s, federal lawmakers introduced wholesale electricity markets following a period of poor generator performance and escalating prices as new, high-cost generating plants came online.[85] The wholesale markets were designed to meet short- and long-term requirements for grid reliability at the lowest cost. Federal policymakers saw competition among electricity suppliers as a means to control prices by attracting new sources of private investment for newer, less expensive technologies.[86] The clearing price for electricity in wholesale markets is determined by an auction in which generation resources offer a price at which they can supply a specific number of MWh of power. This results in lowest-cost power sources, wherever they are located, providing electricity to wherever it is needed, spanning over a wide region.

Many states that pursued restructuring of the generation aspect of the utility business also required that utilities divest their ownership in generation capacity. That capacity was converted from utility ownership to independent power producer status, effectively transitioning those assets from the traditional cost-of-service regulation model to a market-based model under which they earn a market price for their output.[87]

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[84] Zhou, Shengru. *An Introduction to Retail Electricity Choice in the United States*. United States: N. p., 2017. Web. https://www.nrel.gov/docs/fy18osti/68993.pdf

[85] A wholesale market refers to the buying and selling of power between generators and resellers. Resellers include electricity utility companies, competitive power providers, and electricity marketers. For most regions within the United States, the operation of and transactions in wholesale markets are regulated by the Federal Energy Regulatory Commission. A wholesale market allows generators to connect to the grid and generate electricity after securing the necessary approval. The electricity produced by generators is bought by an entity that will often, in turn, resell that power to meet end-user demand.

[86] PJM Factsheet, "The Value of Markets", downloaded from: https://www.pjm.com/-/media/about-pjm/newsroom/fact-sheets/the-value-of-pjm-markets.ashx

[87] Borenstein, S, Bushnell, JB. The U.S. Electricity Industry after 20 Years of Restructuring. Annu. Rev. Econ. 7: Submitted. Doi: 10.1146/annureveconomics-080614-115630.
Available at: https://ei.haas.berkeley.edu/research/papers/WP252.pdf

It is not necessary to require divestiture of generation assets by utilities in order for a state to pursue membership in a wholesale market, but it is an option that increases competition.

Increased competition in the supply of energy could potentially benefit North Carolina's utilities and customers by driving down electricity prices and generating innovation through increased competition among power generators, maintaining a more reliable grid by expanding generation options, and advancing a cleaner grid by leveraging regionally available renewable resources. However, these outcomes are not a given and therefore any action taken by the state to deregulate aspects of the utility industry should be studied, as recommended below.

NC explored deregulation in the early 2000s and determined to be in the state's best interest to remain in a regulated market. The NC Association of Electric Cooperatives and its members do not support deregulation due to its potential impact to serving members and contributing to a rural-urban divide.

States and utilities have widely used quantitative assessments to evaluate whether joining wholesale markets could be net beneficial for affected utilities and customers. Examples include:

- The Federal Energy Regulatory Commission (FERC) and Entergy's retail regulators held a technical conference in Charleston, South Carolina in 2009 that was attended by Entergy and many of the entities that purchase and/or sell energy in the Entergy region. FERC agreed to fund a study on the costs and benefits of Entergy and Cleco Power joining the Southwest Power Pool (SPP). The cost-benefit analysis was performed over a seven-month period, and included an open and collaborative discussion with stakeholders on the study framework, modeling approach, input assumptions, interim results, and qualitative issues. Based on the analysis performed, the study concluded that Entergy and Cleco Power joining the SPP RTO will yield significant economic benefits to the collective SPP/Entergy region.[88]

- The Mountain West Transmission Group (MWTG) is an informal collaboration of electricity service providers that are working to develop strategies to adapt to the changing electric industry. Based on the results of extensive evaluations, MWTG decided to focus its attention on seeking membership in an existing RTO. In January 2017, MWTG announced it was entering into discussions with SPP as the next step in exploring potential RTO membership. As part of the 5-stage new member integration process, SPP staff performed an analysis of the costs and benefits resulting from MWTG membership impacts to current SPP members.[89]

- Multiple utility-specific assessments of the costs and benefits of joining the Western Energy Imbalance Market (EIM) have been conducted since the EIM was created in 2014.[90] The EIM is a real-time power market in the Western United States that balances supply and demand over a large geographic area, finding the lowest-cost energy to serve demand. Individual utilities can decide to join the EIM and many have conducted studies of the costs and benefits of doing so.

[88] "Cost-Benefit Analysis of Entergy and Cleco Power Joining the SPP RTO." Prepared for the Federal Energy Regulatory Commission by Charles River Associates and Resero Consulting. September 30, 2010. Available at: https://www.ferc.gov/industries/electric/indus-act/rto/spp/spp-entergy-cba-report.pdf
[89] "10-Year Costs and Benefits to SPP Members of Integrating Mountain West Transmission Group." Prepared by SPP Staff. March 19, 2018. Available at: https://www.spp.org/documents/56652/mwtg%20cba%20report%20for%20spp%20members%20mar-19-2018.pdf
[90] Recent examples of utility studies of joining the EIM can be found on the EIM website: https://www.westerneim.com/Pages/JoinEIM.aspx

The Legislature could authorize a study that assesses the costs and benefits of different options the state has to increase competition in electricity generation, to determine which if any, could provide greater benefits to NC customers than the status quo. It will be important for any such study to carefully examine the potential trade-offs of various options and the possible impacts of those options on NC's priorities, such as increasing clean energy deployment, enhancing affordability, and maintaining reliability.

The consultant-led study could also look at other options for increasing competition in electricity supply, such as in retail energy supply. Retail electricity choice in the United States allows end-use customers (including industrial, commercial, and residential customers) to buy electricity from competitive retail suppliers.[91] Similar to wholesale markets, retail electricity choice was introduced with the idea that increased competition would result in lower prices, improved service, and innovative product offerings. Some argue that a competitive environment also results in suppliers offering more clean energy options to customers as a way to differentiate themselves from their competitors.

Table B-4: Actions for Recommendations B-4

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature / DEQ	Authorize a consultant-led study that assesses the costs and benefits of different options the state has to increase competition in electricity generation, to determine which if any, could provide greater benefits to NC customers than the status quo.	Medium or long term

[91] Zhou, Shengru. *An Introduction to Retail Electricity Choice in the United States*. United States: N. p., 2017. Web. https://www.nrel.gov/docs/fy18osti/68993.pdf

C. Require comprehensive utility system planning processes

Background and Rationale

Across the country, states are reforming the utility planning process. As the electricity system becomes more dynamic, there is a growing need to move towards more comprehensive planning processes that take into account the different layers of the grid. Streamlining traditionally disparate and serial tasks related to planning and procurement into a unified process can allow system planners to optimize investments in generation, distribution, and transmission.

Utilities and their customers, as well as third parties, can derive substantial benefits from comprehensive planning, including:

- Lowered system costs to reduce rate pressure in a low load growth environment;
- More cost-effective programs and procurements; and
- Enhanced utility, customer, and DER provider relationships as interest in DER continues to grow.[92]

Improved planning can give customers and developers the opportunity to propose, provide, and be compensated for grid services, while experiencing more efficient and predictable interconnection processes. Regulators can benefit from increased transparency and data access for optimal solution identification and more meaningful engagement with utilities and other stakeholders.[93]

NC's current path of incremental improvements to a traditional planning process is not adequate to meet the challenges of integrating high renewable and distributed energy penetrations, which are, in turn, necessary for the state to achieve goals set out in this plan related to economic growth, long term affordability and price stability, and carbon reductions. The state's current IRP process does not include explicit clean energy goals,[94] which could inhibit the ability of the energy sector to achieve clean energy and environmental goals. Additionally, the current IRP process does not include transparency in its goal-setting and lacks rules governing stakeholder involvement prior to IRP submissions.[95] The NCUC is currently looking at ways to expand the scope of utilities' IRP processes, but there are more holistic approaches to planning for generation, distribution, and transmission resources that should be considered.

Duke Energy has acknowledged it needs to update its planning processes and has already begun developing an Integrated System Operations Plan (ISOP).[96] Duke Energy has stated that it is important to

[92] Volkmann, Curt. *Integrated Distribution Planning: A Path Forward*, GridLab, April 2019. (Volkmann, Integrated Distribution Planning: A Path Forward)
[93] Id.
[94] Notable legislative exceptions include HB 589 and Clean Smokestacks.
[95] Utility System Planning and Investment Stakeholder Group Memo.
[96] Duke Energy introduced its Integrated System Operations Planning (ISOP) initiative in its 2018 Integrated Resource Plans. ISOP is focused on developing modeling tools and analytical processes that will complement the existing IRP processes and tools and ultimately allow for optimizing capacity and energy resource investments across Generation, Transmission, Customer Delivery and Customer Solutions. An important objective of this effort is to enhance modeling of non-traditional solutions for Distribution and Transmission Planning so that multiple types of value can be captured. Duke indicates that they plan to hold stakeholder engagement sessions to share

get input from customers and other stakeholders as they seek to enhance and further integrate planning processes and are working toward launching a stakeholder process focused on an ISOP model, as announced at the Grid Modernization stakeholder webinar in April of 2019.[97]

NC can look to states already developing and implementing holistic planning processes, which balance the goals of the state, utilities, and stakeholders. Key examples include Minnesota, Nevada, and Hawaii:

- In 2015, the Minnesota Public Utilities Commission opened an inquiry into distribution planning (Docket 15-556), aiming to incorporate DER with the appropriate optimization tools and create a transparent grid leading to an enhanced grid, reduce costs, and a more flexible and DER capable system. Ultimately, the multi-year process now requires the regulated utilities (Xcel Energy) to develop DER growth scenarios for 10 years, evaluate non-wire alternatives, detail DER queue status, and file annual updates on their 5 and 10-year distribution investment plans.[98]

- Nevada's legislature passed a bill in 2017 (SB 146) to address distributed resources along with their cost, benefits, financial compensation mechanisms, integration, and barriers to adoption. The Public Utilities Commission began the rulemaking process in 2017 (Docket 17-08022) leading to an adopted Distributed Resource Plan regulation. The regulation requires a system load/DER forecast, locational net benefit analysis, hosting capacity analysis, and grid needs assessment, filed every 3 years with the IRP.[99]

- Hawaii's IOU (Hawaiian Electric) started developing its Integrated Grid Planning (IGP) process in 2018 (Docket 2018-0165), a program which incorporates generation, distribution, and transmission planning. The IGP process includes utilization of a capacity expansion model, a substation load and capacity analysis, hosting capacity analysis, and extensive stakeholder input. The IGP process will produce a 5-year action plan and a long-term pathway to achieve the legislative goal of 100% renewable energy.[100]

information regarding ISOP with stakeholders and gather input regarding the approach, using a third-party facilitator selected jointly by Duke and the NCUC Public Staff.

[97] Utility System Planning and Investment Stakeholder Group Memo, Addendum: Duke Energy's Ongoing Integrated System Operations Planning (ISOP) Efforts.

[98] Minnesota Public Utilities Commission, "Order Approving Integrated Distribution Planning Requirements for Xcel Energy," August 30, 2018 ("Order Approving Integrated Distribution Planning Requirements for Xcel Energy").

[99] Nevada Public Utilities Commission, "Order on Commission's Investigation and Rulemaking to Implement Senate Bill 146." September 6, 2018.

[100] Hawaiian Electric, *Integrated Grid Planning*. Accessible at: https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning

Recommendations

C-1. Establish comprehensive utility system planning process that connects generation, transmission, and distribution planning in a holistic, iterative and transparent process that involves stakeholder input throughout, starting with a Commission-led investigation into desired elements of utility distribution system plans.

To respond and adapt to the many trends and forces changing the electricity sector today, it is necessary that NC move to a more holistic, iterative, and transparent planning process that incorporates non-traditional market solutions, which could lower generation and infrastructure costs while still maintaining a clean, reliable, and affordable electricity system. Planning processes should be consistent, data-driven, and involve stakeholders' input and feedback throughout.

An improved planning process could be enabled by the NC legislature and overseen by the NCUC. Legislation could define goals, necessary steps, and what roles the NCUC will play, giving explicit authorization where it is currently vague or lacking under existing law.

One feasible way to get started on a process to move toward a more holistic electricity sector planning process would be to initially begin an investigation into the desired elements of an Integrated Distribution Plan (IDP). The links between IDP, IRP, and transmission planning could be explored throughout this investigation.[101] Options and best practices to consider through an IDP include:

- Explicit consideration of the impacts from all DER types, including EE and demand response, in load forecasting and transmission, distribution and integrated resource planning.
- Enhanced forecasting to reflect the uncertainties of DER growth and its impact on load and peak demands.
- Analysis of the distribution systems' constraints and needs, as well as the ability to accommodate DER without requiring upgrades (i.e., hosting capacity analyses).
- Identification of locational value for nodes on the distribution system where DER deployment could provide grid services.[102]
- Consideration of third-party DER or portfolios of DER to address grid needs as non-wires alternatives (NWA).
- Acquisition of NWA grid services from customers and third parties using pricing, programs or procurement.
- Active monitoring, management and optimization of DER.
- Streamlined DG interconnection processes using insights from the distribution system capacity analyses.
- Increased external transparency through enhanced data availability and meaningful stakeholder engagement.[103]

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[101] The connections between these three types of planning processes, and ways to find synergies and streamline the processes in order to make them more efficient and effective are currently the subject of a Task Force of states convened by NARUC and NASEO. NC's NCUC, DEQ and Public Staff are participants in this Task Force and may have ideas and lessons learned from that process to bring to bear on any IDP process launched by the state.
[102] Analysis of locational value should include both the costs and benefits of the resource where it exists on the system and any impacts it might have on the bulk electric system.
[103] Volkmann, Curt. *Integrated Distribution Planning: A Path Forward*, GridLab, April 2019. (Volkmann, Integrated Distribution Planning: A Path Forward)

Ultimately, the State should move towards an Integrated System Operations Plan (ISOP) approach, which combines resource, transmission, distribution planning. The ISOP processes should include regularly scheduled plan submissions to allow for stakeholder intervention early and throughout the process. These submissions should utilize existing analytical tools, as well as improved data and modeling access for industry and stakeholders.

While the NCUC is addressing some of these new planning approaches in its current IRP proceeding (Docket No. E-100, Sub 157),[104] and the NC Transmission Planning Collaborative (NCTPC)[105] is focusing on enhancing transmission planning in the state, the NCUC should initiate a separate process to create the guidelines for future comprehensive system planning, initially focusing on distribution planning. The outputs of this process can then feed into existing processes, such as NCUC's IRP proceeding, Duke's ISOP efforts, and NCTPC's discussions, as appropriate.

Table C-1: Actions for Recommendation C-1

Entity Responsible	Actions	Timing (Short, Medium, or Long term)
NCUC	Initiate and oversee comprehensive system planning process with meaningful stakeholder participation, starting with integrated distribution planning, including identifying key steps and timelines	Medium term
All	Work with NCUC in designing and implementing comprehensive system planning process	Medium term
Co-ops and Municipal Utilities	NCEMC and ElectriCities develop a process and guidance for member companies to undertake more comprehensive planning	Medium term

[104] NCUC has scheduled a Technical Conference in late August 2019 that will focus on expanding the scope of the IRP process, including ways to identify the locational value of DERs.
[105] NC Transmission Planning Collaborative: http://www.nctpc.org/nctpc/

C-2. Expand cost-benefit methodologies used to make decisions about resources and programs to include societal and environmental factors.

State public utility commissions have typically employed a 'least cost' framework for assessing whether a utility's investment is prudent. Under the least cost framework, the optimal choice is the least cost investment after accounting for other factors such as reliability, state renewable energy or EE mandates, other legal obligations, and a range of risk factors. Least cost is not a rigid standard, however. The approach allows utility regulators to exercise discretion to choose among sources of information, desirable outcomes, and risk assessments. New information, changing market conditions, more stringent regulations, and emerging technologies can all alter the math.[106]

Identifying least cost investment options that will be in service over the next one to two decades is particularly complex due to the increased level of uncertainty regarding technology, markets, and regulation. If projections used in long-term planning do not consider the potential cost impacts of changing policy circumstances, such as the potential for policy shifts to require utilities to internalize environmental externalities, the planning process may not be producing the least-cost outcomes in the long-term.

To achieve NC's carbon reduction goals, utilities need to update planning assumptions, as well as program cost-effectiveness methodologies, to allow for more complete quantification of the operational benefits of energy and technology resources, including societal and environmental factors that may be hard to monetize. Benefit-cost analyses also should take into account locational and temporal values, when available, to provide a more granular assessment of proposed investments.

For resources to be more accurately accounted for in utility planning and programs, regulators should consider a range of non-energy benefits, including the following list. A final list of non-energy benefits will be derived from a process that includes stakeholder input and involvement

- Increased system resilience, reliability, and safety
- Reduced customer costs; especially for low-income, disadvantaged communities
- Increased customer satisfaction
- Health impacts
- Increased customer flexibility and choice
- Enhanced social equity or environmental justice
- Environmental benefits, such as avoided GHG emissions
- Economic development benefits, such as job growth
- Physical and cyber security

Rhode Island and California both have recently updated what benefits and costs should be considered in program evaluation and planning and could be considered by NC in an investigation into this topic:[107]

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[106] Public Comments submitted by Jonas Monast, UNC Chapel Hill, School of Law
[107] In addition, Arkansas, Connecticut, Minnesota, New Hampshire, Pennsylvania, and Washington all are exploring how to update current cost-effectiveness procedures to account for an expanded set of benefits and costs. See:

- In 2016, the Rhode Island Public Utilities Commission opened a docket to get stakeholder input on (a) new rate design principles and concepts, and (b) cost-effectiveness for EE and other types of DERs.[108] One of the reasons for opening the docket was to develop a cost-effectiveness framework that can be applied consistently across different types of ratepayer-funded resources and programs. After months of stakeholder discussions, the Working Group recommended expanding the Rhode Island Total Resource Cost (TRC) Test to include a broader range of benefits to better align with its applicable state policies. The new cost-effectiveness test was named "the Rhode Island Test" and includes: risk impacts, environmental impacts (including GHG emissions reductions), jobs and economic development impacts, societal low-income impacts, public health impacts, and energy security impacts. The Commission accepted the recommendations of the Working Group, and directed the utility company to use the new Rhode Island Test, to the extent possible, for evaluating the cost-effectiveness of EE, DERs, other Company investments and spending.

- California utilities' annual Grid Needs Assessment (GNA), which is part of its distribution planning efforts, describes the performance requirements for any DER solution identified, including the magnitude, duration and frequency of resources required to address each grid need. The GNA uses a Locational Net Benefits Analysis (LNBA) framework, which includes a broad range of system and societal benefits as the basis for determining the range of value at each location. These benefits include: reliability and resiliency, avoided GHG emissions, and other safety/societal benefits.[109]

Other resources are available to NC as it considers revisions to benefit-cost methodologies. For example, the National Standard Practice Manual (NSPM) is a framework for cost-effectiveness assessments of energy resources and is designed to help jurisdictions determine what resources meet their specific goals and standards.[110] Another resource is the newly released US EPA "health benefits per-kilowatt hour" tool which lays out region-specific values (in $/kWh) of the outdoor air quality-related public health benefits of investments in EE and clean energy (wind and solar).[111]

Table C-2: Actions for Recommendation C-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)

American Council for an Energy Efficiency Economy [ACEEE], *A New Tool to Improve Energy Efficiency Practices: The Database of State Efficiency Screening Practices [DSESP]*, July 2019.

[108] Rhode Island Public Utilities Commission, Investigation into the Changing Electric Distribution System and the Modernization of Rates in Light of the Changing Distribution System (Docket 4600), "Report and Order 22851," July 31, 2017.

[109] California Public Utilities Commission, Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769 (Rulemaking 14-08-013), "Decision on Track 3 Policy Issues, Sub-track 2," March 22, 2018.

[110] https://nationalefficiencyscreening.org/national-standard-practice-manual/

[111] https://www.epa.gov/statelocalenergy/estimating-health-benefits-kilowatt-hour-energy-efficiency-and-renewable-energy

NCUC	Initiate and oversee a process that is transparent and open to all relevant stakeholders to update benefit-cost methodologies used in decision-making about resources and programs; this process could be a separate PUC proceeding/investigation or be part of the comprehensive planning process referenced in the recommendation above and involve opportunities for stakeholder input and engagement*	Medium term
Co-ops and Municipal Utilities	Initiate and oversee a process involving the public and/or members to update benefit-cost methodologies used in decision-making about resources and programs	Medium term

* It is assumed that the NCUC has existing statutory authority to pursue this recommendation. In the event that it is determined that the NCUC does not have sufficient authority, legislation would be needed to provide the appropriate authority.

C-3. Implement competitive procurement of resources by investor-owned utilities

Many states, and the federal government through passage of laws like PURPA, the Energy Policy Act of 1992 and the Energy Policy Act of 2005, have recognized that the power generation aspect of electric utility services is a competitive industry, and no longer ought to be viewed as a "natural monopoly." Some states have chosen to deregulate the power generation side of the utility business, which has resulted in the creation of retail energy providers and regional transmission and generation dispatch entities such as PJM Interconnection. Others have modified their integrated resource planning processes to require utilities to consider non-utility generation in their planning processes by conducting competitive procurement of needed resources. In this instance, a completed IRP becomes the precursor for approval of the utility's proposed means for meeting identified resource needs. A competitive procurement model means that utility self-build options will be one option among many, with the utility pursuing the option (which may come from a competitive supplier) that meets the identified need at the least cost. This competition should result in the lowest cost investment being made, ensuring consumers benefit from ultimately lower bills.

Oklahoma and Colorado are two states that have moved to a competitive procurement model for resources. Oklahoma's utility regulations governing IRPs set out procedures for "establishing the need for additional resources serving as the basis for long-term competitive procurement of resources, including, but not limited to, utility construction of new electric generation facilities, the utility purchase of existing electric generation facilities, and the purchase of long-term power supplies."[112] Similarly, Colorado stipulates that an IRP filed by a utility shall include "the proposed RFP(s) the utility intends to

[112] Oklahoma Corporation Commission, Subchapter 37. Integrated Resource Planning.

use to solicit bids for the resources to be acquired through a competitive acquisition process."[113] NC currently does not require utilities regulated by the Utilities Commission to undertake competitive procurement of identified system needs in the IRP process.

Table C-3: Actions for Recommendation C-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Amend IRP rules to include a requirement for regulated utilities to utilize competitive procurement processes to meet identified system needs	Medium term

* It is assumed that the NCUC has existing statutory authority to pursue this recommendation. In the event that it is determined that the NCUC does not have sufficient authority, legislation would be needed to provide the appropriate authority.

[113] Colorado Department of Regulatory Agencies, Part 3: Rules Regulating Electric Utilities, 3064. Contents of the Least-Cost Resource Plan

Strategy Areas & Recommendations

4.3 Grid Modernization and Resilience

Grid Modernization and Resilience

D. Grid modernization to support clean energy resources

D-1: When evaluating proposals for grid modernization, consider whether the following outcomes are supported:
- Demonstrated net benefits for all proposed investments, including presentation of all costs and benefits used in utility analyses,
- Enhanced transparency of regionally appropriate DERs, grid needs and opportunities for DERs to interconnect,
- Increased customer access to their usage data and sources of energy,
- Facilitation of greater utilization of storage, demand-side resources, grid operation/management, devices, and the bi-directional flow of power,
- Measurement of performance to ensure anticipated benefits are delivered and accounted for, and
- Increased deployment of clean energy.

D-2: Use comprehensive utility planning processes to determine the sequence, needed functionality, and costs and benefits of grid modernization investments. Create accountability by requiring transparency, setting targets, timelines and metrics of progress made toward grid modernization goals.

E. Grid resilience and flexibility

E-1: Require utilities to develop projects focused on DERs, community solutions, and microgrids at state facilities and critical infrastructure locations (e.g. hospitals, shelters) to enhance resilience.

E-2: Coordinate resilience planning with disaster recovery operations center and require NC Emergency Management's Recovery Support Functions to address cybersecurity concerns in conjunction with energy resiliency issues.

E-3: Develop a method to quantify the human costs of power outages, and integrate these costs when evaluating grid modernization plan components related to resiliency.

Strategy Area		Recommendation	Legislature	NCUC	Governor's Office	State Agencies	IOU	CO-Ops / Public Utilities	Local Government	Academia	Businesses
Grid Modernization and Resilience	D. Modernize the grid to support clean energy resources	D-1		•				•			
		D-2		•				•			
	E. Strengthen the resilience and flexibility of the grid	E-1		•		•	•	•	•		
		E-2		•		•	•	•			
		E-3		•		•				•	

SHORT TERM | MEDIUM & LONG TERM

D. Modernize the grid to support clean energy resources

Background and Rationale

Distributed energy resources, including EE, demand-side management, solar, and storage have the potential to provide valuable services to the electricity grid and lower costs on the system while providing customers with cleaner power and more control over their energy usage. These benefits along with the falling costs of the technologies themselves are increasing customer and third-party interest in purchasing or investing in these resources. In response, utilities across the U.S. are taking steps to modernize their electric grids, which includes augmenting the grid with software and communications technologies to help the grid meet the new customer, technological, and societal demands.

While NC's adoption of distributed solar generation is still at modest levels, there is growing concern that the grid needs to be upgraded and improved in order to accommodate DER growth and new load from the electrification of end-uses in a way that supports what customers want, maintains reliability, and keeps customer costs down. To carry this out, a thoughtful and methodical approach to grid modernization is needed due to the significant capital expenditures and potential risks proposals may carry. While investments to improve grid capabilities will likely be necessary to enable a clean and resilient electricity system, transparency in grid planning processes can help ensure third parties and customers understand why these investments are needed and what added value they provide to the system.

Recommendations

D-1. When evaluating proposals for grid modernization, consider whether the following outcomes are supported:

- **Demonstrated net benefits for all proposed investments, including presentation of all costs and benefits used in utility analyses,**
- **Enhanced transparency of regionally appropriate DERs, grid needs and opportunities for DERs to interconnect,**
- **Increased customer access to their usage data and sources of energy,**
- **Facilitation of greater utilization of storage, demand-side resources, grid operation/management devices, and the bi-directional flow of power,**
- **Measurement of performance to ensure anticipated benefits are delivered and accounted for, and**
- **Increased deployment of clean energy.**

Duke Energy is currently working on a Grid Improvement Plan which they intend to file in 2019 alongside their next rate case. The NCUC will be the entity responsible for approving the plan and granting cost recovery. The above outcomes emerged through the Clean Energy Plan's stakeholder process as important conditions to consider when evaluating grid modernization plans to maximize the potential benefits of grid modernization investments and to protect against potential utility capital bias.

For an investment to be net beneficial, the benefits (which can include both monetized and non-monetized benefits) from a particular investment should outweigh its complete set of costs. Transparency in cost benefit analyses that shows what costs and benefits are accounted for and their magnitude allows for a more diligent assessment of different technologies' cost-effectiveness. Some proposed investments, such as communication networks and grid automation equipment, may be necessary in order to enable other desired functionality of the grid. In evaluating the costs and benefits of such investments, the importance of sequencing and enabling future functionality should be considered.

As customers transform from mere consumers of energy to active participants in the electricity system, utilities are expected to facilitate additional choices and options for customers as they seek out DER and other services to manage their energy use and costs. Increasing access to data can provide customers with the granular information they need to make more informed decisions about their energy consumption and supply. A more distributed and diverse system will require utilities integrate both customer- and grid-facing technologies to enable a more dynamic grid, such as storage and programmable thermostats.

Operating a dynamic grid will require an increase in availability of transmission and distribution data to enable adequate system monitoring, control, and protection. Transparency of current and anticipated grid needs can streamline interconnection processes and better ensure that new technologies and distributed resources are connected to the grid in areas that can most benefit from them.

Moreover, grid modernization plans should integrate mechanisms for accountability that ensure new grid investments deliver optimized benefits to the grid, customers, and the industry as a whole.

While the NCUC is responsible for approving Duke Energy's Grid Improvement Plan, the same criteria can be applied to co-ops and municipal utilities, who are beginning to consider what grid modernization investments may be necessary on their own systems.

Table D-1: Actions for Recommendation D-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Use recommended outcomes listed above to guide evaluation of Duke's Grid Improvement Plan	Short term
Co-ops and Municipal Utilities	Take into consideration the recommended outcomes listed above when developing grid modernization plans	Medium term

D-2. Use comprehensive utility planning processes to determine the sequence, needed functionality, and costs and benefits of grid modernization investments. Create accountability by requiring transparency, setting targets, timelines and metrics of progress made toward grid modernization goals.

Establishing formal procedures and requirements for future grid modernization plans will result in a more streamlined and transparent process. For IOUs, providing a set of planning requirements prior to the submission of a grid modernization plan will ensure that technologies are deployed strategically and on an as-needed basis. Grid modernization should be directly linked to and informed by the more holistic planning process described above and should include needed improvements to both the distribution and transmission systems.[114] For example, requiring development of different DER penetration scenarios or a more granular system assessment (e.g., at the circuit level) can help identify which new investments are necessary to maintain reliability. Alternatively, improving the linkage between transmission, resource, and grid modernization planning may better identify solutions to transmission system constraints that could be prohibiting greater levels of renewable generation on the system in the eastern part of the state.[115]

Directing utilities to include detailed and clear analysis of cost and benefits in planning processes will ensure approved investments are net beneficial.[116] Making sure utilities establish performance metrics, targets, and accompanying timelines, will allow regulators to hold utilities accountable for plan implementation and ensure that new investments are delivering expected benefits in a timely manner. For municipal utilities and co-ops, these methods can be directly integrated into system planning processes.

California and Minnesota are looking for opportunities to better integrate their planning and grid modernization processes, as described below:

- California has established a Grid Modernization Guidance framework that defines the scope of what can be considered as grid modernization and establishes a structure and timing of grid modernization planning process, including the submission of a Grid Needs Assessment that results from the state's distribution resource planning process. The framework also provides guidance on how to evaluate the cost effectiveness of grid modernization investments and establishes submission requirements.[117]

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[114] See "B: Require comprehensive utility system planning processes"

[115] The low cost of land in the eastern part of the state has led to large volumes of solar development to concentrate in one area of the state where the electrical infrastructure is constructed with smaller conductors. The demand for electricity in this area is low due to the absence of large commercial and industrial customers. According to Duke Energy, this has resulted in significant transmission congestion in the eastern area the state and is now causing an expectation for thermal overloads on the existing transmission lines which move power from east to the load centers west of the coast. Duke Energy states that at least 123 substations have the potential to back feed to the transmission system on certain days throughout the year due to solar systems on the distribution system, and 60% of the projects queued in the Duke Energy Progress service territory are currently interdependent to required transmission network upgrades. Relieving this congestion will require significant investment in the transmission network system.

[116] In reality, for various reasons utilities will request cost recovery for investments that do not come up in a comprehensive planning process. As with all utility investments, regulators will need to evaluate those investments carefully. By having clear expectations for an integrated planning process and explicitly linking grid modernization to the outcomes of that planning process, regulators can better assess the merits of future utility investment proposals.

[117] Ibid.

- Minnesota combined its grid modernization and distribution planning processes into one multi-year effort. Xcel Energy is required to file 5-year Action Plans for distribution system developments and investments in grid modernization based on internal business plans and insights gained from a DER futures analysis, hosting capacity analysis, and NWA analysis.[118]

Table D-2: Actions for Recommendation D-2

Entities Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Determine how grid modernization can be linked to and informed by comprehensive system planning processes; develop submission requirements, including expectations for grid needs assessments and clear cost-effectiveness parameters.	Long term
Co-ops, Municipal Utilities	Determine how grid modernization can be linked to and informed by other system planning processes	Medium term

[118] Order Approving Integrated Distribution Planning Requirements for Xcel Energy.

E. Strengthen the resilience and flexibility of the grid

Background and Rationale

New definitions and metrics have been developed to monitor the properties of the electric power system as it undergoes its dramatic evolution now and into the future. Two properties that have been important in the past and will be increasingly important in the future are resiliency and flexibility. The Department of Energy's Grid Modernization Laboratory Consortium (GMLC) has developed definitions of several key indicators.[119] The GMLC defines resiliency as "the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents."

Flexibility, on the other hand, is defined as "The ability of the grid (or a portion of it) to respond to future uncertainties that stress the system in the short term and may require the system to adapt over the long term." Flexibility can generally be viewed from two perspectives. First, from an operational viewpoint, flexibility can be thought of as the agility of the electrical network to adjust to known or unforeseen short-term changes, such as abrupt changes in load conditions or sharp ramps due to errors in renewable generation forecasts. Second, from a strategic investment perspective, flexibility can be considered as the ability to respond to major regulatory and policy changes and technological breakthroughs without incurring stranded assets. All of these factors are at play in NC.

In the United States generally and in NC specifically, there is a growing frequency and intensity of weather-related disasters. Between 1980 and 2019, more than 241 separate $1 billion disasters have cost the United States $1.6T, with nearly half of the cost coming in 2005, 2012, 2017, and 2018.[120] NC's distinctive geography – with mountains in the west and the Atlantic Ocean to the east – make it particularly susceptible to weather-related disasters in both the winter and the summer. NC is one of the four states[121] most heavily impacted by hurricanes, with the state impacted by a tropical cyclone every 1.3 years.[122]

The state of NC – like any state in the US – is also prone to cyberattack. This is a growing concern as the state becomes more reliant on third-party owned distributed generation.

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[119] "Grid Modernization: Metrics Analysis Reference Document, Version 2.1," Grid Modernization Laboratory Consortium, May 2017. https://gmlc.doe.gov/sites/default/files/resources/GMLC1%201_Reference_Manual_2%201_final_2017_06_01_v4_wPNNLNo_1.pdf

[120] Bloomberg, "U.S. Hurricane Season Is Unnecessarily Dangerous", 6/11/19, https://www.bloomberg.com/news/articles/2019-06-11/u-s-hurricane-season-is-unnecessarily-dangerous

[121] Hurricane Research Division (2008). "Chronological List of All Hurricanes which Affected the Continental United States: 1851–2005". National Oceanic and Atmospheric Administration., https://web.archive.org/web/20080921102626/http:/www.aoml.noaa.gov/hrd/hurdat/ushurrlist18512007.txt

[122] NC State Climate Office, https://web.archive.org/web/20100330154058/http://www.nc-climate.ncsu.edu/print/8

Recommendations

E-1. Require utilities to develop projects focused on DERs, community solutions, and microgrids at state facilities and critical infrastructure locations (e.g. hospitals, shelters) to enhance resilience.

A microgrid is a small electric system that combines local energy resources and control technologies to provide power to a defined area. Microgrids typically remain connected to the main grid, but they can operate independently. They are typically deployed at critical infrastructure locations such as hospitals, but they can also be deployed for all or part of a community. These microgrids allow entities to operate as small islands when the larger grid is experiencing a major outage, and thus they represent an excellent opportunity for providing greater resiliency in the face of weather-related disasters.

There are several interesting examples in NC. Ocracoke Island, which is accessible only by boat or plane, is powered by a small microgrid connected to the main electrical system through a transmission line fed from Cape Hatteras Electric Cooperative under the Pamlico Sound.[123] If a storm takes down the transmission line for any reason, the island can continue to function. The local microgrid, a cooperative venture between NC Electric Membership Corporation and Tideland Electric Membership Corporation, includes a 3 MW diesel generator and 62 rooftop solar panels that have a 17 kW capacity and are built to withstand winds up to 140 mph. Ten cabinets of Tesla batteries sit on a concrete platform built 4-feet high to stay out of the reach of storm surge. Fully charged, the batteries store 1,000 kWh and dispatch up to 500 kW. An inverter takes the DC power from the batteries to AC power for the grid. Homes and businesses throughout the community also have controllable HVAC and water heaters to help curtail and balance load.

Duke Energy was recently approved for a pilot microgrid in Hot Springs, NC, a remote town with a population of about 600 that is served by a feeder with a history of long-duration outages. Given that Duke Energy anticipated high costs for necessary equipment upgrades, it was proposed to construct a small microgrid that would allow the community to be islanded. The Hot Springs microgrid design includes a 2 MW ground-mounted solar array, a 4 MW battery storage system, and a microgrid controller.[124] The battery is sized to meet 100% of the town's peak load and to provide power for the 90th percentile of load for approximately four hours without any contribution from the solar panels.

Microgrids – used for both community-scale applications and critical infrastructure – could have significant benefits in many parts of NC. In many cases, these microgrids can utilize renewable resources and battery-based energy storage. As noted above, there are already excellent examples in which both IOUs and cooperatives have been able to benefit from the distributed resources installed as part of a larger microgrid. The state should encourage its IOUs and co-ops to consider additional microgrid projects to improve recovery from storm-related issues.

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[123] https://www.cooperative.com/remagazine/articles/Pages/electric-co-op-transforming-microgrid.aspx
[124] https://microgridknowledge.com/hot-springs-microgrid-approved/

Currently, combined PV and energy storage are probably not economical in NC under most traditional cost-benefit calculations as confirmed by the recent energy storage study in NC.[125] If one places a value on the losses incurred from grid disruptions; however, PV+storage can potentially become a fiscally sound investment.[126] The state should examine the viability and benefit of installing several projects at state or locally owned facilities that are in particularly storm-prone areas. As these projects proceed, the state should disseminate the results to promote similar thinking in the private sector.

Table E-1: Actions for Recommendation E-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Initiate a docket to require utilities to develop additional projects focused on DERs, community solutions, and microgrids at critical infrastructure locations	Medium term
IOUs, Municipal utilities, co-ops	Consider locations for adoption of microgrids considering factors such as long-term maintenance cost and cost of recovery after major storms	Medium term
Local governments	Consider the full cost of outages when performing cost-benefit analysis for PV+Energy storage. Encourage projects for schools, first-responder facilities, etc.	Medium term
DEQ and Division of Emergency Management	Assist project implementation and leverage federal government infrastructure funding for state projects	Medium term

[125] https://energy.ncsu.edu/storage/wp-content/uploads/sites/2/2019/02/NC-Storage-Study-FINAL.pdf
[126] https://www.energy.gov/sites/prod/files/2018/03/f49/Valuing-Resilience.pdf

E-2. Coordinate resilience planning with disaster recovery operations center and require NC Emergency Management's Recovery Support Functions to address cybersecurity concerns in conjunction with energy resiliency issues.

The NC Disaster Recovery Framework (NCDRF) was developed by NC Emergency Management (NCEM) and is updated on an annual basis. The Framework describes the role of state agencies and their partners in assisting with recovery efforts and is designed to address the complex and unique nature of disasters. Successful recovery efforts rely upon the Whole Community. The NCDRF considers the impacts of grid-related disasters, including threats from tropical cyclones, winter storms, and cyberattacks. The framework is an evolution from the operational plan previously maintained by the state.[127]

The current framework is focused on how the state should respond to and recover from disasters. Inherently, the approach is focused on recovery. Recent studies have shown that every dollar spent on disaster preparedness can offset as much as six dollars spent on recovery efforts.[128] The state should thus consider how to integrate resiliency planning – both for storm-related outages as well as cyberattacks – into its disaster recovery planning, including how assets can best be deployed to reduce recovery efforts.

For example, microgrids installed at critical infrastructure such as hospitals and first-responder facilities can potentially make first response efforts more effective. The state should study the impact of such investments and potentially consider several pilots. Ultimately, such planning should be incorporated into the NCDRF.

Table E-2: Actions for Recommendation E-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NC Division of Emergency Management and Office of Recovery and Resiliency NCORR	Investigate the impacts of resiliency planning as part of the NC Disaster Recovery Framework. Determine if appropriate resiliency efforts can offset costs for disaster recovery.	Short term
DEQ, NCUC, Utilities, NCDOT	Participate and support in updating the NC Disaster Recovery Framework as needed.	Short term

[127] https://files.nc.gov/ncdps/documents/files/2018%20NC%20Disaster%20Recovery%20Framework_Final_0.pdf
[128] https://www.bloomberg.com/news/articles/2019-06-11/u-s-hurricane-season-is-unnecessarily-dangerous

E-3. Develop a method to quantify the human costs of power outages, and integrate these costs when evaluating grid modernization plan components related to resiliency.

The economic and human impact of recovery from a major storm can be incredibly significant. It has been estimated, for instance, that the true cost of Hurricane Katrina was over $250 billion once one includes damage and economic impact. Further, Katrina displaced some 770,000 residents.[129] Such events can have an extremely negative long-term impact on the economic health and culture of a region. As recent storm seasons have shown, NC is also prone to potential major impacts as well. The state is also susceptible to potential cyber threats, and the growing deployment of third-party owned, distributed energy resources potentially makes the state more vulnerable to cyber threats.

Investing in resources that provide greater resiliency can be very expensive. For example, grid-hardening measures and selective installation of microgrids may be excellent for preventing major long-term outages, but the cost must be borne by the ratepayers and those costs may be deemed too high for ratepayers to bear. If one begins to consider the total cost of outage prevention – including the regional economic impact and the impact on individual families that come from large storms – it is possible that the upfront cost of targeted resiliency measures can become more palatable. Similar arguments can be made for efforts to harden the grid against cyber threats. The state should encourage a deeper investigation into this question, and this investigation should be based on the true social and economic impacts of recent events in NC. This analysis should be conducted in a way that promotes social and economic equity, for example by being careful not to calculate the human cost of outages differently for communities of different economic means. The study should also include the impacts of potential cyber threats. DEQ has received a recent award from the US DOE that should help in this area.

Table E-3: Actions for Recommendation E-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
DEQ, UNC-Charlotte, NC State University, NCUC	Investigate the inclusion of the impact of storms and cyberattacks on the economy and society as a whole. Determine if this analysis can be used to modify the regulatory structure to encourage greater investment in DERs, microgrids, and grid-hardening approaches.	Medium term

[129] https://www.thebalance.com/hurricane-katrina-facts-damage-and-economic-effects-3306023

Strategy Areas & Recommendations

4.4 Clean Energy Deployment & Economic Development

Clean Energy Deployment and Economic Development

F. Customer access to clean energy

- F-1: Consider revisions to clean energy programs authorized by HB 589 to ensure successful delivery of desired outcomes, such as increasing customer access to clean energy.
- F-2: Enact a statewide commercial Property Assessed Clean Energy (PACE) and Pay as You Save Program.
- F-3: Develop a green energy bank or statewide clean energy fund to catalyze the development and expansion of clean energy markets by connecting private capital with clean energy projects.
- F-4: Require utilities to offer virtual or group net metering to enable greater access to community solar.
- F-5: Increase the existing REPS or create a new policy with zero-emitting resource targets without carve-outs for specific resources.

G. DER interconnection and compensation for value added to the grid

- G-1: Develop rates that provide accurate price signals to demand-side resources about costs and value to the grid, such as Time of Use (TOU) or real time pricing. In the long term, consider establishing new rate and compensation structures for DERs based on the value of grid services that can be provided by DERs, such as a "value of DER" tariff.
- G-2: Consider ways to provide greater transparency of system constraints and optimal locations for distributed resources.

H. Clean energy economic development opportunities

- H-1: Identify and advance legislative and/or regulatory actions to foster development of North Carolina's offshore wind energy resources.
- H-2: Create and foster statewide and regional offshore wind collaborative partnerships with industry, the public, stakeholders, and neighboring states to bring economic growth to North Carolina.
- H-3: Conduct an assessment of offshore wind supply chain and ports and other transportation infrastructure to identify state assets and resource gaps for the offshore wind industry.
- H-4: Develop pathways to expand renewable natural gas recover and usage.

Strategy Area		Recommendation	Legislature	Utilities Commission	Governor's Office	State Agencies	IOU	CO-Ops / Public Utilities	Local Government	Academia	Businesses
Clean Energy Deployment and Economic Development	F. Enable customers to choose clean energy	F-1	•			•					
		F-2	•			•	•	•			
		F-3			•				•	•	
		F-4	•								
		F-5	•	•							
	G. DER interconnection and compensation for value added to the grid	G-1		•				•			
		G-2		•							
	H. Clean energy economic development opportunities	H-1				•					
		H-2			•	•	•		•	•	•
		H-3				•			•	•	•
		H-4			•					•	

SHORT TERM   MEDIUM & LONG TERM

F. Enable customers to choose clean energy

Background and Rationale

Utility customers in NC are increasingly demanding access to clean energy and EE options for meeting their electricity needs. Cities and counties across the state have adopted clean energy and carbon mitigation goals. Corporations and businesses continue to push utilities and policymakers to make it easier for them to meet their power needs with clean energy. Throughout the Clean Energy Plan public engagement process, participants reiterated and restated the desire for access to clean energy in different ways. Participants generally do not feel that the existing regulatory structure in NC gives customers sufficient and equitable access to clean energy.[130]

NC has made progress toward expanding customer access to clean energy in recent years. In particular, the passage of HB 589 created several new programs that have opened up new avenues for customers to choose clean energy, including community solar programs, solar rebates, solar leasing, and the Green Source Advantage program, which allows large businesses, the military, and universities to directly procure renewable energy. The Competitive Procurement of Renewable Energy (CPRE) program ensures that cost-competitive renewable energy is being brought onto Duke Energy's system which will increase the amount of renewable energy that all of the utility's customers receive through their standard utility service.[131] Participants in the CEP process acknowledged that improvements have been made in recent years to increase customer choice and access to clean energy, while also highlighting areas for continual improvement.

Some of the existing tensions regarding customers' ability to choose clean energy center around the affordability and accessibility of the existing programs. Some examples include:

- Solar rebate program: due to its popularity and the total capacity limits established under HB 589, this program became fully subscribed very quickly. In order to get a rebate, customers had to sign up within a narrow time window which meant that many potential customers were unable to access a rebate.

- Green Source Advantage program: the bill credit that participants receive under this program is revised every 5 years, which can make it challenging for participants to determine the economics of participating in the program. Further, this program is available exclusively to large commercial customers (based on specific demand thresholds), the UNC system, and military installations.

- Businesses do not have the ability to enter into their own on-site third-party PPAs for renewable energy. However, as established by HB 589 they do have the ability to enter into a lease agreement with a similar financing structure to a third party PPA.

- Community solar: HB589 required Duke Energy to develop a community solar program, but there is no statewide program in place meaning that customers of other utilities only have access to community solar if their utility opts to provides it. The state also does not allow virtual net metering, which would expand customer access to shared renewable energy.

[130] See CEP participant survey responses.
[131] The CPRE program is discussed in greater detail in the next section.

The upfront cost of investing in customer-sited resources, like solar and EE, continues to present a barrier to adoption for many NC residents. In particular, low and moderate income residents face many challenges when trying to adopt clean energy. On top of that, many of these same communities face disproportionate burdens from energy production, generation, and use, and would benefit especially from measures that increase non-emitting sources of energy. Some of the recommendations included in this section address issues related to access to capital. Other recommendations directed at specifically enhancing equitable access to clean energy are included in the next section.

Customers in areas served by cooperatives and public utilities expressed similar desires to choose clean energy that is affordable. The programs being implemented under HB589 do not apply to these areas, although several cooperatives are creative in developing and implementing community solar programs for their members.

Recommendations

F-1. Consider revisions to clean energy programs authorized by HB 589 to ensure successful delivery of desired outcomes, such as increasing customer access to clean energy.

HB 589 created new ways for NC customers of Duke Energy to purchase clean energy as the source of their electricity, such as community solar programs, solar rebates, solar leasing, and the Green Source Advantage program. The NCUC has been taking action on utility proposals within each of these programs. Some of the programs are already being implemented, such as the solar rebate program. The Green Source Advantage Program was recently approved by the Commission and but has not yet been implemented by the utility.[132]

Participants in the CEP process, both within the facilitated workshops and through other means, expressed concern that the manner of implementation of these programs will not achieve the full potential for customers to participate. The reasons for this concern vary by program, and, given the early stage of implementation, it is too early to definitively determine whether changes to the programs are needed in order to achieve successful outcomes. The Legislature should revisit these programs in the future, assess whether the desired outcomes are materializing, and consider revisions if needed.

It should also be noted that successful implementation of these programs could be aided by addressing some of the underlying structural challenges built into the existing utility incentives and tools, as discussed in the prior section. In short, existing utility incentives to increase sales and to build utility-owned generation are in conflict with measures designed to increase customer-, third-party-, or community-owned generation resources or to reduce sales of electricity through conservation or behind-the-meter generation. If entities in the state are successful at implementing changes to address these existing challenges, the underlying incentives of utilities can be better aligned with the overarching goals of clean energy programs such as those created by HB 589.

[132] See NCUC August 5, 2019 Order approving Duke Energy's compliance filing: https://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=a6e3fb12-1347-476d-b612-b35a077ffa85

Table F-1: Actions for Recommendation F-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature / DEQ	Revisit HB 589 programs and consider whether revisions are needed to ensure desired outcomes are achieved.	Short-term

F-2. Enact a statewide commercial Property Assessed Clean Energy (PACE) and Pay as You Save Program

The inability to finance EE upgrades and distributed renewable energy projects was identified by stakeholders in the Clean Energy Plan process as a major barrier that the state should address. The financing difficulties arise from a number of causes: the split incentive between landlords and tenants means that neither entity has the incentive to invest in EE or clean energy; for commercial customers, investments in the core business are often prioritized over energy upgrades even when they are cost effective; and external financing can be hard to come by, particularly for small businesses.[133] For residential customers, particularly lower income customers, the inability or unwillingness to take on personal debt in order to finance upgrades or new measures is a major barrier. Two financing mechanisms, Pay As You Save (PAYS) and Commercial Property Assessed Clean Energy (C-PACE), were identified as promising mechanisms to help address some of the barriers.

Pay As You Save is the name of a voluntary program design through which a utility can offer to make site-specific investments in EE upgrades at a customer's property. The utility recovers its cost for the investment with a charge on the customer's electricity bill, with the charge being lower than the estimated savings that result from the EE upgrade. As a result, the customer gains the benefit of net savings from the start of the program. A key feature of the PAYS model is that the cost recovery for the upgrades is tied to the utility meter, rather than an individual person. The PAYS model has been used successfully around the country as a way to remove barriers affecting customer segments that are hard to reach like renters and customers without access to upfront capital. One electric co-op in NC, Roanoke Electric, has been successfully using PAYS to upgrade roughly 200 homes per year. To date, no other NC utilities have offered an on-bill tariffed program like PAYS. Stakeholders identified the need for some kind of loss protection for utilities that might be concerned that their programs would not perform well, and thus they would need risk mitigation in order to offer such a program. A clean energy fund, discussed in the next recommendation, could offer a reserve fund to provide loss protection for utility tariffed on-bill programs like PAYS.

C-PACE is a mechanism targeted at the commercial sector and is strictly property-based financing, requiring no personal or corporate guarantees. A property owner works with a contractor to determine which clean energy upgrades make sense, and 100% of the financing (for both hard and soft costs) is

[133] Third-party financing often requires personal guarantees and/or some equity investment, both of which can be prohibitively difficult for small business owners.

provided as a loan through the PACE program. A local government entity (occasionally regional or statewide entities) sets up the program and services the loan, placing an annual assessment on the property for debt collections. With PACE, the financing is repaid as a line item on the property tax bill, which means that the obligation to repay the financing can transfer to a new owner upon sale of the property. C-PACE can remove or greatly reduce several of the barriers to investing in EE or clean energy that commercial property owners might face. PACE is already legislatively authorized in NC, but the state does not have any active programs. The NC Cities Initiative identified a few reasons for this, one being that NC local governments lack familiarity with using this kind of financing, and would benefit from the ability to delegate the administration of such a program and the financing mechanism to a central third party. In addition, state-level approval is needed for all local debt.

Table F-2: Actions for Recommendation F-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Utilities (IOU, Co-ops, Public utilities)	Develop voluntary on-bill pay as you save tariff, using Roanoke EMC as an example of successful application in NC	Short term
Legislature	If needed to ensure access for customers, direct utilities to develop a tariffed on-bill financing program like PAYS and make it available as an option for customers	Long term
Legislature	Consider setting up a loss reserve fund or a revolving loan fund to speed up implementation of PAYS	Medium term
Legislature	Re-authorize NC PACE law, which currently sunsets in July 2020	Short term
Legislature	Give local governments authority to delegate administration of C-PACE to a statewide or regional third party entity	Short term
Legislature / DEQ	Evaluate the feasibility of easing the requirement for state-level approval of local debt	Medium term

F-3. Develop a green energy bank or statewide clean energy fund to catalyze the development and expansion of clean energy markets by connecting private capital with clean energy projects.

Throughout the Clean Energy Plan stakeholder process, a diverse group of individuals and other energy collaborators identified a need for an NC clean energy fund.[134] A clean energy fund could bring capital dollars to clean energy projects in areas and markets that are not yet attractive to large investors. By helping to structure and underwrite deals with a reasonable return, a clean energy fund could simultaneously spur new projects and catalyze investment markets.

Participants in the CEP process identified particular needs for project funding in clean energy, EE, electric vehicle infrastructure, and other measures that reduce emissions. They noted particular need in rural and poorer communities of the state that otherwise lack access to necessary capital. Similar funds in other states have supported the installation of residential, community, municipal, and commercial solar systems; EE upgrades in public schools and homes; and infrastructure deployment for alternative fuel vehicles.

Table F-3: Actions for Recommendation F-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NGOs and Academia	Determine how to establish a NC Clean Energy Fund[135]	Short term
Governor's Office	Publicly support a NC Clean Energy Fund if established	Short term

[134] These collaborations included the Cities Initiative and the EE roadmap process. The need for such a fund was also identified by the CEP stakeholder breakout group focused on Equitable Access and Just Transition.
[135] As of the writing of the Clean Energy Plan, DEQ is aware that the Nicholas Institute at Duke University is intending to engage with the Coalition for Green Capital, a leading expert and implementer of green banks, in Fall of 2019 to produce an in-depth report on the creation and design of a NC Clean Energy Fund.

F-4. Require utilities to offer virtual or group net metering to enable greater access to community solar.

Many customers want access to solar energy but they do not have the ability to put solar panels on their roof or property, or the ability to pay the significant upfront costs for an individual solar system. The community solar model allows customers to subscribe to a portion of a solar facility's output through their utility, or be a joint owner of such a facility, without having the facility physically located on their property. House Bill 589 required Duke Energy to offer at least 20 MW of community solar in each of its territories. These programs are under development and review at the Utilities Commission. Eleven of NC's electric co-ops offer a community solar program to their members.[136] Community solar can expand equitable access to clean energy by allowing individuals and businesses to participate regardless of whether they own their home, their income level, or the suitability of their property for solar development. CEP stakeholders attending the workshops as well as private citizens participating in the regional listening sessions expressed a strong desire to make these services available to communities interested in these programs.

One of the key elements of community solar programs is the subscriber compensation, which determines the value that subscribers are paid for their share of the generation from the project. Typically, this compensation is provided through a credit on the electric utility bill. The methodology for determining the credit to subscribers greatly affects the overall economics of the community solar project from the subscribers' perspective, and thus also affects the cost to subscribe and overall market demand for the program. If the result of the crediting methodology is that subscribing to community solar requires paying a premium on electric bills, it will make access to the program much more difficult for low- and moderate-income customers.

States and utilities are taking a variety of approaches to subscriber compensation within community solar programs but the majority are using some form of retail rate compensation or a value-of-solar methodology.[137] In order for retail rate compensation to be feasible, "virtual net metering" must be available. This means that net metering applies to community solar subscribers in proportion to their subscription to the solar array, and allows customers to receive credits from community solar as though the generation were on site. In NC, customers who have solar on their rooftops are eligible for net metering, meaning that they receive credits for the energy they send to the grid that helps to offset the energy they consume on-site. However, subscribers to a community solar array do not have this option because NC currently does not have a statutory requirement for utilities to provide virtual net metering. Rather, in NC the compensation is based on the utility's avoided cost rate, meaning that the credit received by subscribers is lower than the cost they pay for the energy they consume.

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[136] National Rural Electric Cooperative Association, see: https://www.electric.coop/wp-content/Renewables/community-solar.html?lipi=urn%3Ali%3Apage%3Ad_flagship3_feed%3BQhg%2BM6GlTBW3BEUMJftgjA%3D%3D&utm_source=Insights+Jan&utm_campaign=bd960c642c-EMAIL_CAMPAIGN_2017_12_14&utm_medium=email&utm_term=0_d0de398254-bd960c642c-126666693

[137] Cook, Jeffrey J., and Monisha Shah. 2018. Focusing the Sun: State Considerations for Designing Community Solar Policy. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-70663. https://www.nrel.gov/docs/fy18osti/70663.pdf

It should be noted that some states that offer a form of retail rate compensation for community solar subscribers do not offer the full retail rate. They do this to reflect the fact that some elements of the utility's costs to serve subscribers, such as some aspects of transmission and distribution, are not offset by the generation from the community solar array. For example, in Delaware the bill credit is based on the full retail rate if the subscribers are on the same feeder as the solar array, otherwise a supply service charge is subtracted from the credit that subscribers receive. It would be sensible for regulators and decision makers to consider the appropriate credit for subscribers in different utility service territories.

Table F-4: Actions for Recommendation F-4

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature	Require utilities to develop virtual net metering for community/shared solar customers and direct the NCUC and other utility governing bodies to oversee appropriate development of compensation rates for subscribers	Short term

F-5. Increase the existing Renewable Energy and Energy Efficiency Portfolio Standard (REPS) or create a new policy with zero-emitting resource targets without carve-outs for specific resources

NC has been a leader on clean energy policy in the Southeast and is the only state in the region with a renewable energy portfolio standard. This policy has helped to drive much of the clean energy development in the state and has led NC to a #2 ranking in installed solar capacity in the US. That said, NC's REPS policy is one of the least aggressive in the country; several states increased their renewable energy targets to 50% and higher by 2030 and beyond in recognition of the economic and environmental benefits that can be realized. As modeling by DEQ and others shows, the state's "business as usual" policy landscape is not likely to result in clean energy development sufficient to increase deployment beyond the amount codified in HB589 or in sufficient quantities to meet the state's GHG reduction goals. In addition, customers are increasingly expecting that the electricity they purchase from their utility will come from clean sources.

Different options for increasing the amount of clean, zero-emitting generation on the grid were discussed by stakeholders in the Clean Energy Plan process. One option is to simply increase and extend the current REPS policy by adding targets for 2030 and 2050, maintaining the current resource carve-outs or establishing additional resource carve-outs. Another option is to allow the REPS to coexist alongside a new policy that would require a certain percentage of generation to come from zero-emitting resources by 2030 and 2050, without any carve-outs for specific technologies. The latter would allow all zero-emitting generation resources to compete to be the preferred option for meeting the target.

Table F-5: Actions for Recommendation F-5

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature / NCUC	Expand the State's REPS by setting higher targets for 2030 and 2050 while maintaining existing technology carveouts, or develop a technology neutral policy that requires a certain amount of electricity sales to come from zero-carbon emitting sources by 2030 and 2050.	Medium term

G. DER interconnection and compensation for value added to the grid

Background and Rationale

As costs for clean energy and storage continue to fall, states, regulators and utilities around the country are grappling with ways to facilitate interconnection of these new resources to the electric grid while maintaining reliability and fairly compensating (and charging) distributed resources for the value (and costs) they bring to the grid. These challenges and opportunities are not unique to NC – other states and utilities have engaged in dockets and investigations into the value of distributed resources and initiated pilots to test out new compensation structures and rate designs.[138]

There is an interest among NC customers and developers for siting solar projects on the distribution grid and getting compensated by the utility for services provided. While there has been less development of smaller, distribution-connected projects to date, with the continuing cost declines for solar and storage it is likely that more customers will be interested in installing DERs and interconnecting to the distribution system. If given the opportunity, aggregators could work with multiple customers to create solar, storage and/or demand response programs that can provide value to the utility grid and savings to the participating customers.

NC already has significant amounts of distributed generation, primarily solar. The majority of the solar projects in the state are utility-scale, representing 36% of all PURPA capacity in the U.S from 2008 to 2017.[139] During the early development of solar, utilities in the state were able to study and connect large quantities of projects at low cost to the developer. As development continues, the upgrades necessary to connect new solar resources increases and, as these costs increase, the economics of solar development become more challenging.

Another issue currently slowing down development of solar is the delay in utility interconnection processes. As a result of projects concentrating in the same area, a serial study process (e.g., one project studied for interconnection after another) creates a long queue with each subsequent project relying on information related to the completion of the preceding project. Duke Energy states that at least 24 substations have 4 or more large scale projects that are requesting interconnection, with thirteen projects requesting interconnection at one substation. The NCUC is currently considering moving from a serial study process to a grouping study process for interconnection. Grouping studies resolve interdependency by studying all projects at the same time, thus eliminating the multi-year delays related to the serial queue studies. It also sets up methodologies for cost sharing between projects which is not permitted today, and may ultimately support the economics of more projects as a result of spreading the cost of upgrades across more volume. For example, when a project triggers an upgrade today, that project is responsible

[138] Some suggested resources on this topic include: "The Role of Distributed Energy Resources in Today's Grid Transition," authored by GridLab and GridWorks for Utah Clean Energy, August 2018. Available at: https://gridlab.org/works/role-of-distributed-energy-todays-grid/ and
Orrell, AC, JS Homer, and Y Tang, "Distributed Generation Valuation and Compensation," Pacific Northwest National Laboratory, February 2018. Available at: https://www.districtenergy.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=0103ebf1-2ac9-7285-b49d-e615368725b2&forceDialog=0
[139] Energy Information Administration. August 2018 Monthly Data. https://www.eia.gov/electricity/monthly/

for all of the upgrades which could be tens of millions of dollars. Under the grouping study procedure, numerous projects may share the costs of the upgrades.

The Competitive Procurement for Renewable Energy Program (CPRE) established under HB 589 (2017) created a competitive bidding process for renewable energy projects. Utilities provide locational guidance, and generators receive payments tied to the utility's avoided cost. This process does not require the developer to pay for the network upgrades, as these are funded by the utilities and put into rates. The necessary upgrades are determined by grouping all of the CPRE competitive bidders to be studied together and costs are then allocated to each of the participating projects. To receive an award, projects must meet a two-part test. First, the project price bid added to the levelized cost of system upgrades must be lower than the administratively determined avoided cost. Second, the project price combined with the cost of upgrades must also be among the lowest cost of the suppliers competing for the defined procurement volume. The CPRE process by law is administered by an Independent Administrator selected by the NC Utilities Commission (NCUC). Duke Energy expects that 1,460 – 1,960 MW of projects will be developed under the CPRE. Tranche 1 of CPRE was completed in July of 2019 and the median price was about $7 below the administratively determined avoided cost. Duke Energy estimates the expected nominal savings to customers over the 20-year term of these contracts to be over $260 million compared to relying on an administratively determined price.

The recommendations in this section focus on creating opportunities for DERs to access markets and value streams while allowing developers and customers interested in installing DERs to better understand the opportunities and constraints on the grid.

Recommendations

G-1. Develop rates that provide accurate price signals to demand-side resources about costs and value to the grid, such as Time of Use (TOU) or real time pricing. In the long term, consider establishing new rate and compensation structures for DERs based on the value of grid services that can be provided by DERs, such as a "value of DER" tariff.

DERs, which include distributed solar, but also things like storage, EE, demand response and electric vehicle charging, can help make the grid more flexible, resilient, reliable, and clean while also giving customers more control over their energy use. For the efficient deployment of DERs to be feasible in the future, rates and compensation structures will need to be in place that compensate DER customers for the benefits DER provides to the grid, charge those customers properly for their use of the grid, and allow utilities to recover the revenue required to maintain a safe and reliable system. Ideally, these rate and compensation structures would send price signals that encourage customers to install and operate DERs in a way that is beneficial to the system as a whole. Participants in the Clean Energy Plan process identified the development of such rate and compensation structures as important for the cost-effective deployment of these resources in the state.

States and utilities are approaching these issues in different ways. Many, including California, Minnesota, Maryland, and Arizona are moving toward time-varying rates which price electricity higher when demand is greater and when the system is more stressed. See adjacent table for an explanation of the types of time-varying rates.

Types of Time-Varying Rates	
Time-of-use (TOU) pricing	Different time periods throughout the day (e.g., peak period, off-peak period, mid-peak period) have different electricity prices. The time periods and prices remain the same from day to day.
Variable peak pricing	Time-of-use pricing, plus a feature whereby the price for the peak period changes daily to reflect system conditions and cost. Prices in other periods do not change from day to day.
Critical peak pricing	A limited number of times per year, the utility calls a "critical event" during which the grid is expected to be very stressed. Prices over the timeframe of the event (usually limited to a few hours) increase dramatically. Can be coupled with TOU rates or standard flat rates.
Critical peak rebate or peak time rebate	A limited number of times per year, the utility calls a "critical event" during which the grid is expected to be very stressed. During the timeframe of the event, customers are compensated for cutting back on electricity use. Can be coupled with TOU rates or standard flat rates.
Real-time pricing	Prices vary hourly throughout the day to reflect actual fluctuating electricity costs determined by wholesale prices.

These kinds of rate designs more precisely communicate the value of DER services, such as solar or storage that provides power to the grid during peak times, or demand response programs that help shave peaks. Time-varying rates are one way to enhance the potential value that DERs can provide to the system.

Another potentially complimentary approach is to create a separate tariff that creates a value stream for services provided by DERs. Implementation of such a tariff would provide utilities and third parties with more information about areas where EE and other DERs are valuable and send price signals to encourage the development of DERs. Development of such a tariff is a complex and technical process that involves a myriad of considerations. Some of those considerations include:

- how and whether to determine locational and temporal values,
- the number of years to offer compensation under such a tariff,
- what values to include in the methodology, and
- what resources should be eligible for the tariff.[140]

A foundational challenge for developing a value of DER tariff is the need for data that illuminates the surrounding distribution grid needs and potential value streams that DERs can provide. This type of advanced distribution system data can be made available through a variety of processes as deemed

[140] Hall et al, "Locational and Temporal Values of Energy Efficiency and other DERs to Transmission and Distribution Systems," Synapse Energy Economics, 2018. Available at: https://www.synapse-energy.com/sites/default/files/ACEEE-Paper-Values-EE-DER.pdf

appropriate by regulators, and requires investments in grid modernization equipment that are currently being discussed by other stakeholder initiatives in the state.

One approach to such a tariff, being taken in New York, bases the value on the utility's avoided costs plus other DER values including wholesale energy and capacity, distribution capacity, and environmental values. Depending on the structure of the tariff, other potential values that could be included are avoided losses, generation capacity, energy, ancillary services, transmission capacity, and distribution services such as voltage support, reliability and resilience.[141] It should be noted that in New York (and in other states, as well), net metering continues to be in place for solar customers while the value of DER methodology is being developed.[142] This approach for solar customers is appropriate for NC as well. Stakeholders and regulators will need to grapple with the considerations and data issues outlined above in determining whether and how net metering for solar customers can and should evolve.

Table G-1: Actions for Recommendation G-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Ensure utilities are offering time-varying rates that encourage DER deployment that is beneficial to the system and allows customers to take advantage of cost-saving benefits of DERs	Short term
NCUC	Open a docket to consider the need for the appropriateness, feasibility, and structure of a "value of DER" tariff	Short to medium term
Co-ops and Municipal Utilities	Encourage DER deployment by evaluating the feasibility and effectiveness of time-varying rates and implement and develop appropriate programs	Medium term

[141] For more information, see NYSERDA's website at: https://www.nyserda.ny.gov/All%20Programs/Programs/NY%20Sun/Contractors/Value%20of%20Distributed%20Energy%20Resources

[142] State of New York Public Service Commission, (2017, March). Order on Net Energy Metering Transition, Phase One of Value of Distributed Energy Resources, and Related Matters. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BA04D9EF3-9779-477E-9D98-43C7B060DAEB%7D.

G-2. Consider ways to provide greater transparency of system constraints and optimal locations for distributed resources

Information and transparency about grid needs and constraints is a foundational requirement in order for non-utility actors to compete fairly in the provision of clean energy and grid services. In the current regulatory framework, information asymmetry means that third party providers of distributed resources like solar, storage, or electric vehicle charging face difficulties in choosing locations, types, and sizes of projects to propose or develop. These resources could provide tangible benefits to the utility system in the form of increased flexibility and cheaper and cleaner generation sources, and to individual customers, in the form of clean energy and reduced bills.

As discussed in the recommendations around comprehensive system planning, analyses to develop more detailed, location-specific information about grid needs and constraints is considered a central feature of integrated distribution planning and in determining grid modernization needs.[143] Equitable access to relevant information not only helps smaller scale developers of solar (under 1 MW) determine the best locations to propose projects, it can help customers who wish to install solar PV better understand the right size of a system to install in their particular location to avoid grid upgrade costs. It can also help third party installers of electric vehicle charging infrastructure determine the best locations for charging stations from the perspective of limiting impacts on the grid. The Commission could consider requiring an assessment of the full costs and benefits of conducting such an analysis in the context of an investigation into distribution system planning, as recommended above.

More detailed, location-specific information about grid needs and constraints also benefits developers and providers of larger scale DERs, such as those entities that wish to participate in the CPRE program. Duke Energy agrees that locational information is important for finding the right place on the grid for a new project, and if done right, this can save customers money.[144] More detailed information about the current capacity of substations and transmission lines to accommodate additional solar development would make proposals to the CPRE more precise and valuable to the utility system, making them potentially more likely to be chosen through the competitive process.

Projects developed outside of the CPRE would also benefit from increased transparency about grid needs and constraints. For those projects, the NCUC is currently considering moving to a grouping study process similar to that which is utilized in CPRE. There are likely multiple benefits from moving to a grouping study process, including eliminating multi-year delays and allowing cost sharing between projects.

It may also be worth considering other solutions in areas where the transmission system is so constrained by generation development that neither CPRE nor grouping studies can improve the economics. In this case the legislature could provide guidance to the NCUC to establish a process for utilities to build out clean energy transmission solutions, which could ultimately be put into rates for all customers while expanding the delivery of clean energy within the state.

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[143] Volkmann, Curt. *Integrated Distribution Planning: A Path Forward*, GridLab, April 2019. (Volkmann, Integrated Distribution Planning: A Path Forward)
[144] See Duke Energy comments to DEQ

Table G-2: Actions for Recommendation G-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Consider conducting a full assessment of the costs and benefits of requiring utilities to undertake analyses that would provide customers and third parties with greater transparency of grid constraints and needs (e.g., hosting capacity analysis) in the context of distribution system planning	Medium to long term
NCUC	Require Duke Energy to provide more detailed information about the current capacity of substations and transmission lines to accommodate additional solar development in the context of the CPRE program	Short term (e.g., before the next tranche)

H. Clean energy economic development opportunities

Background and Rationale

Similar to the economic growth experienced in the solar sector, significant opportunity exists to build the clean energy economy through the development of offshore wind energy projects and supply chain. Additionally, NC's potential to produce renewable natural gas (RNG) from swine waste, food and solid waste operations, landfills and wastewater treatment plants offer an opportunity to grow the rural economy and reduce GHG emissions.

Offshore wind energy (OSW) represents a low-cost, clean, and reliable energy resource for NC. Our state has the second-highest average wind speeds on the Atlantic coast and is well-positioned to participate in this rapidly growing global industry. OSW development provides an opportunity for hundreds of millions of dollars in economic development and thousands of new jobs in eastern NC, as well as a significant increase in clean energy generation and energy diversification for the state. State commitments to OSW in the Northeast have led to record-breaking bids of more than $100 million each for the right to further assess wind energy areas (WEAs) leased to OSW industry giants by the federal Bureau of Ocean Energy Management (BOEM) for development. Applying the best practices and lessons learned from over 18 GW of OSW installation within the European Union, this industry is expected to create a $70 billion supply chain and tens of thousands new jobs in the United States by 2030.

Development of OSW energy resources is underway off NC's coast. The Kitty Hawk WEA, located 24 nautical miles from Corolla, is over 122,000 acres in size and is under lease by Avangrid Renewables. According to the developer, the Kitty Hawk project will boast a capacity of 2,400 MW. Avangrid is finalizing its planning, assessment, and stakeholder outreach necessary to submit its formal Site Assessment Plan (SAP) to BOEM in the summer of 2019.[145] After receiving approval of the SAP, Avangrid will prepare a detailed plan for the construction and operation of a wind energy project and conduct environmental and technical evaluations. Construction and installation of the Kitty Hawk project could begin as early as 2023, and plans anticipate operations at the facility beginning in 2025. BOEM has identified two additional WEAs off the coast near Wilmington, and new OSW would increase interest in the OSW industry of developing those areas.

Executive and legislative mandates are in effect in many Atlantic states to attract OSW development. Mandates in the following states establish OSW procurement goals and in some cases timelines.[146] These procurement requirements, combined with any state-offered incentives, send clear market signals that both leverage and attract OSW industry investment.

Despite strong leadership on OSW from our northern neighbors, additional OSW development has stalled in NC in part because of a lack of strong pro-OSW market signals by the state. Additional OSW-related topics for further attention include local concerns around visibility and the need for onshore transmission

[145] For more information about the BOEM WEA selection and development process, see: https://www.boem.gov/Renewable-Energy-Program-Overview/ and the wind energy chapter in the accompanying Supporting Document on NC's Energy Resources.
[146] New York (by executive order, 9000 MW by 2035); New Jersey (by executive order, 3500 MW by 2030); Maryland (by legislation, 1200 MW); Connecticut (by legislation, 2000 MW); Massachusetts (by legislation and executive order, 3,200 MW by 2030); and Virginia (by legislation, 12 MW; by executive order, 2500 MW by 2026)

infrastructure to bring OSW-generated energy inland to load centers. The state should engage with Duke Energy and Dominion Energy on transmission infrastructure needs, addressing expedited siting, and permitting for right-of-ways to prepare NC's grid in order to deploy this valuable energy resource. In addition, the Utilities Commission could fast-track the process for determining the Certificate of Public Convenience and Need for OSW-generated wind resource development and necessary transmission.

Other Atlantic Coast states are gaining a competitive advantage and creating and sustaining high-wage jobs that could, and should be, available to NC's businesses and workforce. To capture these opportunities and ensure NC's competitive edge, the state must take proactive steps on OSW. A comprehensive assessment of state infrastructure (ports, rail, etc.) as well as supply chain assets and potential is a key next step. This assessment will provide a clearer picture of NC's capabilities and inform the state's path forward on OSW-related investments and economic development. In parallel, DEQ and other agencies will evaluate best practices from other states and identify OSW policy actions that make sense for NC.

Recommendations

H-1. Identify and advance legislative and/or regulatory actions to foster development of NC's offshore wind energy resources

A common characteristic among U.S. states realizing industry investment in development of offshore wind projects and the associated supply chain is the presence of state action incentivizing OSW. Capital flows toward certainty. OSW developers and manufacturers are attracted to states that have a high potential wind resources as well as a predictable and hospitable business environment.

While multiple Atlantic states have established strong OSW-related policies, the form of the policies vary. Several states have legislative mandates that require specific OSW procurement on a designated time frame. Virginia's legislature, for example, determined that OSW development is in the "public interest," a conclusion that enabled the state public utility commission to authorize an OSW pilot program. DEQ will work with other agencies and stakeholders to identify the design of legislation and/or regulatory action appropriate for NC.

Table H-1: Actions for Recommendation H-1

Entity Responsible	Action	Timing (Short, medium, or long-term)
DEQ	Based upon an evaluation of best practices for legislative and regulatory action that promote business certainty for the OSW industry, identify and advance strategic actions for NC.	Short term

H-2. Create and foster statewide and regional offshore wind collaborative partnerships with industry, the public, stakeholders, and neighboring states to bring economic growth to NC.

NC and its neighboring states seeking offshore wind development and economic opportunities would benefit from a regional effort to coordinate regional resources in a way that fosters development of a robust OSW industry and energy market in the Southeast. NC and partner states could evaluate their collective assets for OSW development, streamline state regulatory requirements, collaborate on educational programs and requirements for job training, and create a forum for sharing information and best practices related to OSW development. The partner states also could also coordinate engagement with federal agencies, such as BOEM.

Table H-2: Actions for Recommendation H-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Governor's Office or Cabinet-level executives	Work to establish a regional agreement for multi-state cooperation on OSW	Short term
OEMs, energy developers, IOUs, local government, research institutions, academic and training entities, etc.	Engagement with industry which may include: regional promotion of OSW assets for supply chain investment; developing and implementing best practices; coordinating communications; and identifying funding streams to facilitate research and other activities that enhance OSW and industry recruitment	Short term
OSW developers	Location of OSW component manufacturing, supply chain investment, facility, and jobs in NC	Medium term

H-3. Conduct an assessment of offshore wind supply chain and ports and other transportation infrastructure to identify state assets and resource gaps for the offshore wind industry.

An assets and capabilities analysis specific to the needs of the OSW industry would signal to developers and original equipment manufacturers (OEMs) that NC wants to participate in this industry. Such an analysis would evaluate existing supply chain and port infrastructure assets, assess NC business advantages and economic climate, evaluate current workforce readiness – building on the Department of Commerce's clean energy workforce assessment completed pursuant to §5 of EO 80. Additionally, the analysis would identify potential infrastructure and other investments necessary to provide services for cargo, transportation, trade related to OSW, and the transmission required to accommodate OSW-generated energy. Results of the study could include estimated manufacturing and supply chain jobs that could be created to serve the OSW industry, opportunities for rural economic development, benefits to local and state tax bases, and other economic benefits. The objective of conducting this type of analysis is to determine how NC can successfully position itself to compete in OSW as well as pinpoint our state's advantages to attract industry segments, such as blades, towers, and wind turbines (nacelles). More specifically, the assessment would evaluate:

1. The State Ports at both Wilmington and Morehead City to determine what infrastructure upgrades are needed to support OSW industry
2. The workforce assets in place, expected employment needs, and training requirements
3. The needs of industry partners related to manufacturing facilities
4. Items identified by the multistate partnership contemplated in *Recommendation H-2*.

Table H-3: Actions for Recommendation H-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Cabinet agency	Retain a consultant for a supply chain infrastructure assessment for the OSW in NC.	Short term
Dept of Commerce, NC Ports, Dept of Transportation, chambers of commerce, economic developers, local government	Engage key stakeholders in assessment and leverage assessment findings to recruit industry	Short to medium term
Cabinet Agency and academia	Conduct an economic impact analysis for OSW energy development in NC that includes quantifiable impacts on health, environment, emissions, direct and indirect jobs, local and regional tax bases, etc.	Short Term

H-4. Develop pathways to expand renewable natural gas recovery and usage.

The agricultural community sees RNG production as a new "home-grown" industry with the potential to increase employment and revenue generation potential for rural and agricultural communities, create more advanced, sustainable waste management solutions and produce bioenergy that offsets GHG emissions. By 2030, emissions from the agriculture and waste management sectors are projected to be almost 50% of the total emissions from the electricity sector. RNG projects in the State have the potential to significantly reduce these emissions. Furthermore, RNG can reduce reliance on natural gas.

Stakeholders have expressed concerns over air and water pollution from swine operations' use of biogas technology that rely on lagoons and sprayfield waste management systems. Pollution to waterways, odors, and public health concerns for nearby and downstream communities, including those felt disproportionately by minority populations, are the reasons for opposition to biogas production.

The Research Triangle Institute (RTI), Duke University, and East Carolina University are conducting a study to determine the extent and location of available biogas resources in the state and the percentage of

NC's GHG reductions that can be met with biogas. The analysis will include determining the climate, environmental, societal, and economic effects of the use of biogas and will recommend policy measures to accelerate biogas development, and the best uses for the gas (i.e., transportation fuel, RNG/pipeline, on-site energy generation). Implementation pathways for policy measures identifies in this study should address the benefits of biogas as well as environmental and societal impacts.

Table H-4: Action for Recommendation H-4

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Duke University, RTI, East Carolina University	Develop implementation pathways, including strategies to address environmental and societal impacts, for policy measures identified in a study currently underway that will determine the extent and location of available biogas resources in the state and the percentage of NC's GHG reductions that can be met with biogas.	Short term
Energy Policy Council – Energy Infrastructure Subcommittee	Convene a study committee to explore ways to capture and utilize RNG in NC. Topics to study: Ways to increase options and educate producers/ consumers; Consider what policy barriers exist; Feasibility of micro-pipelines to attract economic development; Application of food waste digesters; Supporting disaster related fuel supply needs and resiliency operations, and RNG transport mechanisms to end users and buyers; and evaluation of environmental, societal, and health impacts of biogas development.	Medium term

Strategy Areas & Recommendations

4.5 Equitable Access & Just Transition

Equitable Access and Just Transition

I. Equitable access and energy affordability

- I-1: Include non-energy equity-focused costs and benefits in decisions regarding resource needs, program design, cost-benefit analyses, and facility siting.
- I-2: Examine the feasibility and proper design of a low-income rate class and associated rate structures, including but not limited to the elimination or reduction of fixed charges for ratepayers with high energy burdens.
- I-3: Expand energy efficiency and clean energy programs specifically targeted at underserved markets and low-income communities.

J. Just transition to clean energy economy

- J-1: Ensure inclusion and meaningful involvement of historically marginalized individuals (people of color and people living in poverty) in decision-making regarding siting electricity generation assets and implementing programs that would affect their energy bills, health, and access to clean energy and energy efficiency opportunities.
- J-2: Launch an EE Apprenticeship program within Apprenticeship NC to expand access to clean energy careers.
- J-3: Create long term jobs with family sustaining wages and benefits in renewables and grid infrastructure industries for low income communities and workers displaced by the transition to a clean energy economy.

Strategy Area		Recommendation	Legislature	Utilities Commission	Governor's Office	State Agencies	IOU	CO-Ops / Public Utilities	Local Government	Academia	Businesses
Equitable Access and Just Transition	I. Address equitable access and energy affordability	I-1		•		•	•	•	•		
		I-2		•						•	
		I-3	•			•	•				
	J. Foster a just transition to clean energy	J-1		•		•					
		J-2								•	
		J-3	•				•	•	•	•	•

SHORT TERM MEDIUM & LONG TERM

I. Address equitable access and energy affordability

Background and Rationale

Low income and energy-burdened residents often live in older, less efficient housing which requires more energy for heating and cooling than newer homes. In 2018, those living with incomes below 50% of the Federal Poverty level, spent 33% of their annual income on energy bills (includes electricity, gas and other utilities).[147] In NC, low income residents spent between 17% (homeowners) and 21% (renters) of their annual income on electricity bills.[148, 149]

Low income households may not be able to take advantage of existing programs for clean energy due to up-front costs and financing, physical challenges related to the quality of the building or ownership status of their housing, or simply a lack of access to high-integrity service providers. Low-income customers may lack savings or access to financing. They often have lower credit scores that may disqualify them from financing or lock them into high interest rates that make the benefits of clean energy less attractive. Many of the tax credits for clean energy, such as the federal solar investment tax credit and the EV tax credit, are nonrefundable, which means that individuals cannot directly benefit from these incentives unless they have a tax liability.[150]

Low income households have fewer choices in regard to housing options, with many low income residents living in homes with structural deficiencies that can make EE upgrades inaccessible.[151] Low income households are less likely to own their own homes, especially in urban areas, which makes it more difficult to install clean energy like solar. These households are more likely to live in multifamily buildings without access to their own roof. They often live in housing stock that is older and may be of poor structural integrity. A roof that needs repair is unlikely to be suitable for solar PV.

Energy burdened households struggle to pay unaffordable energy bills. 1.4 million people in NC are paying a disproportionately high amount of their income on energy bills[152] which makes making any investment in things like EE more difficult. Many of the same communities are directly impacted by the health and pollution impacts of energy extraction, transportation and production. These compounding factors mean that these communities are the least able to reap benefits of investments in clean energy and EE while being most impacted by the legacy energy industry.

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147 Ibid

148 Office of Energy Efficiency and Renewable Energy. (2017). Low-Income Energy Affordability Data (LEAD) Tool – OpenEi DOE Open Data (K. Layman, Ed.). Accessed May 2019. https://openei.org/doe-opendata/dataset/celica-data

149 For more information, see CEP Supporting Document – Part 3: Electricity Rates and Energy Burden

150 The *Low-Income Solar Policy Guide* provides a compendium of options and reference materials for addressing financial barriers on its "Financing" page. The recommendation included in this report regarding the creation of a green bank focused on financing clean energy projects would also be a way to address some of these challenges.

151 Drehobl, A., & Ross, L. (2016). *Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low Income and Underserved Communities.* Accessed April 2019. https://aceee.org/sites/default/files/publications/researchreports/u1602.pdf

152 Equitable Access and Just Transition Stakeholder Memo

The recommendations in this section address some of the barriers that low income and energy burdened communities face when it comes to energy affordability and access to clean resources.

Recommendations

I-1. Include non-energy equity-focused costs and benefits in decisions regarding resource needs, program design, cost-benefit analyses, and facility siting.

While utilities currently have programs targeted at low income households and tracks participation, these programs can be improved using a deeper equity analysis. By including equity considerations in these types of decisions, utilities, local government and state agencies can better reflect broader societal costs and benefits of energy production and use, and of EE programs or solar investments.[153] For example, in resource planning the Utilities Commission could consider impacts to low-income, energy burdened or historically marginalized communities when deliberating around utilities' IRP filings. Such consideration could lead to future resource decisions that reduce burden and even provide a benefit to these communities.

In crafting policy and regulatory responses to this recommendation, agreeing upon consistent language and definitions used to describe impacted communities and households will be important. The appropriate definitions for NC were not discussed in the CEP stakeholder process, however, the Nicholas Institute suggests the following terms and definitions for the purposes of crafting equity-focused policies and regulations:

- Household energy burden: the share of a household's income that is spent on specified utilities and heating fuels where the numerator reflects both the household's consumption as well as electricity rates, and the denominator reflects total household income or budget.
- Energy poor households - all those that spend on average more than 6% of their income on meeting energy costs.[154]

Utilities and state agencies could better incorporate equity into program design, such as EE program design, by adding metrics that track how many energy burdened households are enrolled or creating carve-outs designed to ensure certain percentages of program funds are dedicated to those households.

As discussed in recommendation C-2, cost-benefit testing, such as the analysis done to determine how much and what kinds of EE should be implemented, could be expanded to include an assessment of broader costs and benefits, often referred to as "non-energy" costs and benefits. Several states use a variety of methods to place values on societal public health and participant health benefits, and these methods could be explored in NC. Lastly, decisions about siting energy facilities could explicitly include an environmental justice or equity impact analysis.

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[153] Note: elements of this recommendation were discussed in some detail in the section of this report that covers comprehensive system planning.

[154] The Nicholas Institute also suggests that a single threshold of energy burden as defined above does not capture the full story of energy burdened households in the state. The Institute is currently analyzing household income and energy bill data for NC in an effort to identify and characterize "tranches" of energy burden (by locations, home age and type, and demographics) tailored to NC.

Table I-1: Actions for Recommendation I-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Consider impacts to energy burdened households and communities in utility resource planning. In doing so, consider the appropriate definitions of household energy burden, energy poor households and other key terms as discussed above.	Medium term
State agencies, NCUC, utilities, Co-ops, public utilities, local governments	Add equity metrics and elements to program delivery, such as EE programs. In doing so, consider the appropriate definitions of household energy burden, energy poor households and other key terms as discussed above.	Short term
NCUC and DEQ	Consider and evaluate methodology to include broader non-energy equity-focused elements in cost-benefit testing. In doing so, consider the appropriate definitions of household energy burden, energy poor households and other key terms as discussed above. DEQ will provide technical assistance to NCUC regarding methods to assess public health and societal impacts, and siting decisions affecting environmental justice areas and high energy burden communities.	Medium term
NCUC and DEQ	Explore methodologies for including EJ impact analysis in siting decisions. In doing so, consider the appropriate definitions of household energy burden, energy poor households and other key terms as discussed above.	Short term

* It is assumed that the agencies named in this table have existing statutory authority to pursue this recommendation. DEQ did not conduct a thorough analysis of legal authority in conjunction with this plan. In the event that it is determined that entities do not have sufficient authority, legislation would be needed to provide the appropriate authority.

I-2. Examine the feasibility and proper design of a low-income rate class and associated rate structures, including but not limited to the elimination or reduction of fixed charges for ratepayers with high energy burdens.

Low-income customers face a more significant burden in paying their energy bills than other customers of the same "customer class" with higher incomes. Though "affordability" has been a core tenant of utility regulation and system planning, stakeholders in the CEP process identified that there are segments of customers for whom the cost of energy is not affordable and argued that there should be a more nuanced treatment of affordability in utility ratemaking and rate design. This could be accomplished in a number of different ways, such as through a bill discount, a percentage of income payment program, reduction or elimination of fixed charges, or other ways. The NC Utilities Commission could also consider creating a differentiated service classification for multi-family housing, where costs for the utility to provide electric service could be lower. Affordability was not only raised as an issue for customers of IOUs. Rate structures of co-ops and municipal utilities that emphasize fixed charges place disproportionate burden on low-usage customers and low-income customers.

The details of this recommendation, including the proper design of a low-income rate class and the right strategy for addressing affordability for low-income customers, were not able to be tackled by CEP stakeholders in the limited time available. An entity such as a higher education institution could establish a follow-up process involving stakeholders to discuss equity issues within utility ratemaking and recommend actions for legislation and for the NCUC to pursue.

Table I-2: Actions for Recommendation I-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Academia, Non Profits, NCUC	Convene a stakeholder process to discuss equity issues within utility ratemaking and recommend actions for legislation and for the NCUC to pursue	Short term

I-3. Expand energy efficiency and clean energy programs specifically targeted at underserved markets and low-income communities.[155]

Many low-income homes suffer from health, structural or safety issues, such as mold, leaky roofs or faulty wiring, as low-income people tend to live in older buildings and have more limited income to invest in upgrades and repairs. These conditions may prevent the installation of solar or EE measures. Studies have found that a significant portion of low-income homes (more than 10% in one such study) have health and safety issues that prevent providers from delivering weatherization services.[156] Equity-focused policies and programs that address some of these challenges can help ensure that vulnerable communities will benefit from the growing clean energy economy.

There are many existing EE programs in NC, and yet some sectors – including agricultural and multi-family housing – are underserved by these programs. Some existing dynamic incentive programs, such as Duke Energy Design Assistance program, cannot serve multifamily developments due to metering eligibility requirements. Other programs have payback schedules that do not match a sector's situation, or application periods that do not align with complementary funding sources. And although Duke Energy has EE programs specific to low income customers, they do not have a specific target or carve out for how many low income communities get access to funds, so it can vary from year to year how well these programs reach these customers.

Some existing utility EE programs could be tailored to be a "better fit" to address the target markets of agriculture, multifamily, mobile homes, military populations, and houses of worship, and others including small businesses and some industrial customers that are unable to take advantage of utility-offered programs due to the high cost of opting-in to the EE Rider. Fifty percent of low-income populations in NC reside in multifamily residences. However, many developers may not be taking full advantage of existing EE incentive programs in this sector. Opportunities exist to better align multifamily utility EE incentives with new NC Housing Finance Agency projects and their refinancing cycles, and to seek out complementary funding such as US Department of Agriculture (USDA), state weatherization and other non-regulated sources.

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[155] Many of the ideas and some of the text for this recommendation were taken from the EE Roadmap's Recommendation #13 and #16. They have been combined with other ideas and shortened for the purposes of this document. More information on these recommendations can be found in the Roadmap.

[156] Refer, for example, to: (1) Carroll, D., Berger, J., Miller, C., and Driscoll, C. (2014). *National weatherization assistance program impact evaluation: Baseline occupant survey; Assessment of client status and needs*. Oak Ridge, TN: Oak Ridge National Laboratory. ORNL/TM-2015/22. Retrieved from: https://weatherization.ornl.gov/wp-content/uploads/pdf/WAPRetroEvalFinalReports/ORNL_TM-2015_22.pdf; (2) Rose, E., Hawkins, B., Ashcraft, L., and Miller, C. (2014). *Exploratory review of grantee, subgrantee and client experiences with deferred services under the Weatherization Assistance Program*. Oak Ridge, TN: Oak Ridge National Laboratory. ORNL/TM-2014/364. Retrieved from: https://weatherization.ornl.gov/wp-content/uploads/pdf/WAPRecoveryActEvalFinalReports/ORNL_TM-2014_364.pdf; and (3) Green & Healthy Homes Initiative (2010, October). *Identified barriers and opportunities to make housing green and healthy through weatherization*. Prepared by the Coalition to End Childhood Lead Poisoning. Baltimore, MD: Green & Healthy Homes Initiative. Retrieved from: https://www.greenandhealthyhomes.org/wp-content/uploads/GHHI-Weatherization-Health-and-Safety-Report1.pdf. The latter report notes (on page 5) that "Health and safety issues render homes ineligible for weatherization work though the degree may vary between [programs]. Overall, the average number of homes deemed ineligible in the pre-auditing or auditing phase was 12.88%; however, there is a wide variance in why programs find those homes ineligible."

Other unique opportunities exist for targeted sectors, such as a Heat Pump Water Heater (HPWH) rental program for low-income households. The reduction in the upfront cost of the equipment would dramatically increase the adoption of HPWH in low and moderate income communities helping each household significantly reduce energy use for heating water resulting in savings to the resident. In addition, by using HPWH as deployable demand-side management to shift loads off peak through thermal storage, additional utility cost savings and/or funding for programs could be realized.

The NC Weatherization Assistance Program (NC WAP) in partnership with multiple NC utilities is developing a limited community solar pilot for low income households. As discussed in the previous section, community solar allows customers that cannot install solar on their property to benefit from solar energy. Low income households have historically had little or no direct access to solar in NC. This new community solar pilot will give low income households an option to use solar energy to further reduce energy burdens for 15 years or more in addition to having their homes weatherized. The community solar measure is designed to provide each participating low income household an additional $365 in savings per year credited directly to their utility bills. NC WAP is working with its agencies and partner utilities to find approximately 40 eligible low income households within the service territory of the participating utilities. NC WAP plans to expand this low income community solar opportunity to other areas in future years through additional partnerships.

There are existing venues in the state for discussing changes to existing programs in order to better serve low-income and underserved communities. To the extent that new funding is needed to accomplish some of these actions, the legislature or philanthropies could be a source of financial support.

Table I-3: Actions for Recommendation I-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature	Direct utilities to work with stakeholders to identify ways to better serve low-income and underserved communities through existing programs or by creating new program elements, such as a low-income carve out using the improved cost benefit analysis under Recommendation I-1	Short term
DEQ	Evaluate outcomes from NC WAP community solar program and determine ways to expand the program to reach more low income customers	Medium and long term
Duke Energy EE Collaborative	Discuss new program ideas, how better to serve underserved markets, and ways to administer new offerings	Short term
Energy Policy Council EE Committee	Discuss new program ideas, how better to serve underserved markets, and ways to administer new offerings and make recommendations for actions through collaborative partnerships	Medium and long term
Low income advocates	Work with utilities to design and implement programs. In the case of IOUs, these programs would need to be approved by the NCUC.	Medium and long term

J. Foster a just transition to clean energy

Background and Rationale

Throughout history as the economy has changed due to varying factors from trade policy to technological innovation, workers have often suffered disproportionately from these changes. The loss of manufacturing in the textile, tobacco, and furniture industries across NC are prime examples. As NC's energy system shifts toward one focused on clean resources, workers currently employed in traditional energy industries that will be transitioning stand to be impacted. Counties with fossil fuel facilities could lose millions of dollars from their tax base as fossil fuel facilities ramp down, for example. NC should anticipate and manage this transition, by putting worker protections and oversight by those most affected into the state's plans from the beginning.[157]

These concerns are not unique to NC. The Paris Climate Agreement recognized "the imperatives of a just transition of the workforce and the creation of decent work and quality jobs."[158] The International Labour Organization (ILO), a specialized agency of the United Nations, was charged with developing a framework for implementing this principle. In its 2018 Policy brief on the subject, the ILO states that:

> "[t]he idea of just transition should not be an 'add-on' to climate policy; it needs to be an integral part of the sustainable development policy framework. From a functional point of view, just transition has two main dimensions: in terms of 'outcomes' (the new employment and social landscape in a decarbonized economy) and of 'process' (how we get there). The 'outcome' should be decent work for all in an inclusive society with the eradication of poverty. The 'process,' how we get there, should be based on a managed transition with meaningful social dialogue at all levels to make sure that burden sharing is just and nobody is left behind."[159]

Recommendations

J-1. Ensure inclusion and meaningful involvement of historically marginalized individuals (people of color and people living in poverty) in decision-making regarding siting electricity generation assets and implementing programs that would affect their energy bills, health, and access to clean energy and energy efficiency opportunities.

Historically marginalized individuals and communities have largely been left out of decisions that often affect their economic opportunities, environmental quality, health, and wellness. This has led to a cycle of increasing hardship and impacts for these communities, relative to individuals and communities that have greater access and ability to influence decisions. The US EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations,

157 AFL-CIO comments
158 UNFCCC "Paris Agreement." https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf
159 ILO Just Transition Guidelines. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---actrav/documents/publication/wcms_647648.pdf

and policies. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work."[160]

In NC, as in other states, people of color and low-income people are disproportionately impacted by decisions about siting and operating energy facilities, what types of clean energy and EE programs will be available and how those programs will be structured, what utility costs are approved and how utility costs will be recovered from ratepayers, among others. NC must continue to strive for the achievement of environmental justice goals around inclusion and meaningful involvement in decisions like these. Inclusive decision-making processes and meaningful involvement of historically marginalized individuals means seeking input and ideas from the beginning of any given decision process, before options are being developed. It requires concerted effort to reach out to community members, grassroots organizations, and tribal governments to understand how different options will impact them. DEQ will report to the Governor's Office how it is implementing actions that ensure meaningful participation and inclusion of historically marginalized communities and considering impacts on those communities in agency decision making related to energy.

Table J-1: Actions for Recommendation J-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
DEQ	Report to the Governor's Office how it is implementing actions that ensure meaningful participation and inclusion of historically marginalized communities and considering impacts on those communities in agency decision making.	Short term
NCUC	Consult with stakeholders and explore ways to incorporate environmental justice into decisions and make Commission processes more inclusive. Consider adding a required section in future IRPs and other relevant filings that demonstrates inclusion and meaningful involvements of historically marginalized communities.	Short term
DEQ	Support the Environmental Justice and Equity Advisory Board on energy issues by informing the Board of relevant energy issues and supporting their evaluation of those issues.	Short term

[160] https://www.epa.gov/environmentaljustice

J-2. Launch an EE Apprenticeship program within Apprenticeship NC to expand access to clean energy careers.[161]

Apprenticeships and pre-apprenticeships provide opportunities for experiential learning through paid "on the job" training with real companies in the industry. Allowing for both apprenticeships and pre-apprenticeships would ensure that anyone could participate in the program regardless of education level or background. Part of a just transition to the clean energy economy of the future is ensuring that NC residents of all racial and socioeconomic backgrounds have opportunities to find and keep jobs that pay family-sustaining wages. Apprenticeship programs can help create a pipeline of skilled workers for businesses in need of good employees, reduce operational costs by establishing a streamlined channel to bring on new workers and advance existing workers, build employee loyalty and reduce attrition, and foster new leaders.

NC is home to a successful state apprenticeship program. Apprenticeship NC is an economic development-focused organization housed within the NC Community Colleges System. The U.S. Department of Labor has described Apprenticeship NC as an agency that works "to ensure NC has an innovative, relevant, effective, and efficient workforce development system that develops adaptable, work ready, skilled talent to meet the current and future needs of workers and businesses to achieve and sustain economic prosperity." However, currently, Apprenticeship NC does not focus on EE as a career path.

Apprenticeship NC already works in collaboration with the NC Community Colleges System, the NC Department of Commerce, and the US Department of Labor's Bureau of Apprenticeship and Training and currently recognizes building trades and energy industries as part of their apprenticeship programs. This partnership could easily expand to include various EE trades. In order for this to happen, specific EE careers would need to be identified and companies would need to be contacted and asked to participate in the program. To ensure equitable outcomes, specific focus should be made to include small businesses, Historically Underutilized Businesses, and Historically Black Colleges and Universities in this program.

[161] This recommendation is part of the Energy Efficiency Roadmap recommendations and the text in this document was largely copied from the Roadmap. More detail on this recommendation is available in the Roadmap.

Table J-2: Actions for Recommendation J-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Community Colleges System - Apprenticeship NC	Work with the following stakeholders to coordinate and implement EE apprenticeship programs: ● Technical and community colleges ● Traditional colleges and universities ● EE industry employers ● K-12 institutions ● NC Department of Commerce/NCWorks ● Workforce Development Boards ● NC Business Committee for Education Navigator Tool ● Training institutions ● Credentialing organizations such as Building Performance Institute (BPI) ● Local businesses ● Municipalities ● Utilities	Medium term

J-3. Create long term jobs with family sustaining wages and benefits in renewables and grid infrastructure industries for low income communities and workers displaced by the transition to a clean energy economy.

Focusing job training and creation is minority and low-income communities and those where workers are being (or likely to be) displaced by a transition away from fossil fuels will help ensure that all parts of NC can thrive in a clean energy future. This focus is important because these communities are at the greatest risk of suffering economic hardship and growing wealth inequality relative to the wealthier parts of the state. A concerted effort must be made by multiple entities to ensure that these communities are made better off with the transition to clean energy.

Stakeholders in the clean energy plan process identified a few key actions to realize this recommendation, including creating more accessibility to the Registered Apprenticeship Programs by establishing pre-apprenticeship programs in partnership with high schools and community colleges. Various entities could help drive up labor standards by prioritizing contractors that provide good wages, benefits and career pathways. Best practices from around the state and the country for displaced workers from the fossil fuel industry could be collected by government and shared in order to encourage private sector action.

Under direction from EO 80, the Department of Commerce completed its Clean Energy and Clean Transportation Workforce Assessment. This assessment identified occupations, number of jobs for each occupation, and the five-year growth rate for jobs related to the clean energy industries, EE industries, and clean transportation industries. The assessment also provided four recommendations for action to develop a future workforce by bringing together employers, workers, and education and training providers to meet changing needs. The assessment recognizes that the importance of job placement and training need of communities and workers to ensure a just transition.

Table J-3: Actions for Recommendation J-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Utilities and clean energy developers	Work with "High road" contractors or those that provide living wages and benefits and career pathways for workers.	Medium term
Legislature	Consider tax incentives to encourage targeted investment in certain communities, and labor standards	Medium term
Local and Tribal Governments	Use economic development agencies to direct and prioritize investment, use existing powers to direct use of incentives for development	Medium term
Higher Education	Train contractors and workers in clean energy and EE professions, create pre-apprenticeship programs in partnership with the Registered Apprenticeship Programs	Medium and long term

Strategy Areas & Recommendations

4.6 Energy Efficiency & Beneficial Electrification

Energy Efficiency and Beneficial Electrification

- **K. Energy efficiency and demand side management programs**
  - K-1: Establish an Energy Efficiency Advisory Council (EEAC) to oversee implementation of the EE Roadmap recommendations.
  - K-2: Enable customers to have greater access to their energy data through new functionalities, such as those available through Green Button "Download My Data" Button.
  - K-3: Establish minimum EE goals within existing REPS or establish an energy efficiency resource standard (EERS).
  - K-4: Enhance education and awareness around energy efficiency opportunities in K-12 schools and community colleges through an "Energy Efficiency Everywhere (E3)" project.
  - K-5: Require utilities to develop innovative rate design pilots to encourage customer behavior that helps achieve clean energy goals, such as peak demand reduction, better utilization of renewable resources, and strategic storage deployment.
  - K-6: Increase EE awareness on the North Carolina Building Code Council.
- **L. Electrification Strategies**
  - L-1: Require utilities to develop innovative rate design pilots for electric vehicles to encourage off-peak charging of vehicles and to test effectiveness of different rate structures at shifting customer usage of the grid and encourage the adoption of electric vehicles.
  - L-2: Conduct an analysis of the costs and benefits of using electrification to reduce energy burden and GHG emissions in end-use sectors in NC, such as in homes, buildings, transportation, industrial, and agricultural operations.

Strategy Area		Recommendation	Legislature	Utilities Commission	Governor's Office	State Agencies	IOU	CO-Ops / Public Utilities	Local Government	Academia	Businesses
Energy Efficiency and Beneficial Electrification	**K. Increase use of energy efficiency and demand side management programs**	K-1			•						
		K-2	•	•			•	•			
		K-3	•	•							
		K-4								•	
		K-5		•				•			
		K-6	•			•					
	L. Create strategies for electrification	L-1		•				•			
		L-2								•	

SHORT TERM   MEDIUM & LONG TERM

K. Increase use of energy efficiency and demand side management programs[162]

Background and Rationale

EE is widely considered a least cost option for meeting energy demand, while reducing energy costs and carbon emissions. While EE has experienced slow and steady growth in NC, much more can be done to maximize the full potential of this least cost resource. Total retail electricity sales to NC consumers in 2017 was just over 131,000 GWh. Although the state has realized increasing annual incremental EE savings – exceeding 1,220 GWh in 2017 – annual incremental EE savings from utility programs as a percentage of retail sales is still under 1.0%.[163, 164] Each incremental investment in EE accrues multiple benefits to consumers, including lower energy bills, increased grid reliability and the deferral or elimination of expensive new generation, transmission and distribution infrastructure investments – costs that would otherwise be borne by ratepayers.

Despite bipartisan support for the economic and environmental benefits of EE and an increasing focus by advocates, utilities and big energy users, barriers remain to fully realizing EE's potential. To discuss and start to address these barriers, the Nicholas Institute at Duke University, in partnership with NC's Department of Environmental Quality initiated a process to develop a comprehensive state EE roadmap. This initiative, launched in August 2018, convened stakeholders from separate EE working group discussions to think collectively about this issue.[165] Some of the barriers that the EE roadmap stakeholders identified include:

End-user Barriers

- Lack of reliable information about EE opportunities (particularly in rural and agricultural communities)
- EE is often confused with renewable energy

[162] Much of the background and recommendations discussion in this section is taken from the EE Roadmap, with slight modifications and editorial changes made by DEQ.
[163] NC State Electricity Data, Energy Information Administration, Form EIA-861,"Annual Electric Power Industry Report" for the years 2013-2017. https://www.eia.gov/electricity/data/eia861/
[164] Annual incremental energy efficiency is defined as "The annual changes in energy use (measured in MW hours) and peak load (measured in kilowatts) caused by new participants in existing DSM (Demand-Side Management) programs and all participants in new DSM programs during a given year. Reported Incremental Effects are annualized to indicate the program effects that would have occurred had these participants been initiated into the program on January 1 of the given year. Incremental effects are not simply the Annual Effects of a given year minus the Annual Effects of the prior year, since these net effects would fail to account for program attrition, equipment degradation, building demolition, and participant dropouts. Please note that Incremental Effects are not a monthly disaggregate of the Annual Effects, but are the total year's effects of only the new participants and programs for that year." US Energy Information Administration Glossary, accessed 7/3/19. https://www.eia.gov/tools/glossary/index.php?id=I
[165] The EE Roadmap strives to include diverse voices from across the state and identify a variety of paths forward to help all stakeholders seize the EE opportunities in the state. Some of the discussions generated substantial debate and disagreement among various parties that could be impacted by a new paradigm for EE. Much more information about the EE Roadmap collaboration and outcomes, including detailed discussion of the full list of outcomes, can be found in the EE Roadmap document. The recommendations included in the Clean Energy Plan are those that were prioritized as most important by the Clean Energy Plan participating stakeholders.

- Longer payback period for some EE investments as the opportunities for shorter payback investments for "low hanging fruit" (like efficient lighting) have already been realized
- Lack of inclusive financing options

Building Sector Barriers [166]

- NC building code cycle is six years for residential homes, twice as long as best practice in other states, and the state's energy conservation code is falling behind national standards
- Lack of energy managers / EE champions in commercial and small business
- Quantitative analysis (energy audit) of EE opportunities can be expensive

State Regulatory and Policy Barriers

- Federal weatherization funding is limited
- Lack of efficiency mandate for all utilities
- Industrial and large commercial customers are allowed to opt out of utility programs provided they implement EE on their own, making tracking and creating incentives for EE difficult for these customers

Utility Barriers

- Perception that the cost per kilowatt hour (kWh) may increase with additional EE utility investment
- Absent incentives or mandates, the current cost-of-service utility business model is not aligned with EE; investments in EE undercut revenue to the utility in the Near term and deferred or avoided generation, transmission, or distribution investments—while good for ratepayers—limit opportunities for profits to shareholders in the long term.
- Lower avoided costs and advancement of codes/standards create barriers to utility programs under traditional cost-effectiveness tests
- Failure to recognize all energy and non-energy benefits of efficiency in cost-effectiveness tests

Some of the identified barriers, including those related to the cost-of-service utility business model, cost-effectiveness tests, addressing energy burdened communities and hard to reach sectors, and financing options, have been addressed elsewhere in this report through recommendations related to EE and other topics. Additional recommendations included in this section relate to ensuring implementation of EE recommendations are overseen by an advisory committee, giving customers access to their energy usage data, increasing education and awareness of EE opportunities, increasing the EE targets within the existing REPS, better utilization of load flexibility to meet clean energy goals, and building codes. These recommendations come primarily from the EE Roadmap process.

[166] According to NCDEQ's 2018 Greenhouse Gas Emissions Inventory Report, commercial buildings sector was the only sector with increased energy usage between 2005 and 2017 compared to residential and industrial sectors.

Recommendations

K-1. Establish an Energy Efficiency Advisory Council (EEAC) to oversee implementation of the EE Roadmap recommendations

Currently, there is no established body that is diverse and inclusive of all the many EE interests in NC that could oversee and guarantee the implementation of the NC Clean Power Plan EE recommendations. The EEAC would fill this gap and track implementation of the approved recommendations as well as the emissions reductions, economic development benefits and other metrics from EE measures. With a diverse make-up, the EEAC would ensure that balanced, consensus-driven recommendations are made, and that new EE policies are implemented as quickly and effectively as possible. The EEAC would help establish better communication between the EE stakeholders, and improve the sharing of best practices to boost adoption of EE measures within the state.

The NC EEAC could be created within the Executive Branch of NC's government, with a state-wide purview for broadening EE programming.

- The EEAC would target the residential and commercial sectors, but occasionally, could provide oversight to and recommendations for industrial EE initiatives.
- The EEAC would align with the activities of the Energy Policy Council (EPC) to the extent possible.

The EEAC should be comprised of representatives from utilities, state agencies, higher education, industry, advocates and other EE experts. The EEAC would be responsible for sharing information and best practices between stakeholders in order to increase state-wide EE measures for residential and commercial programs across the state in support of the Governor's Executive Order 80. In the near-to-medium term, the EEAC would oversee the implementation of the recommendations selected for inclusion into the state's Clean Energy Plan and help to monitor and report on the progress of the EE recommendations. Long-term, the Energy Policy Council would be responsible for tracking broad EE efficacy in NC and undertake studies and analyses that can inform future EE recommendations.

Table K-1: Actions for Recommendation K-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Governor's office	Establish an Energy Efficiency Advisory Council, appoint a person or entity to chair the council, and align with the activities of the Energy Policy Council to the extent possible.	Short term

K-2. Enable customers to have greater access to their energy data through new functionalities, such as those available through Green Button "Download My Data" Button

The ability for customers to easily access their own energy usage data and authorize that data to be provided to third parties is an essential enabling step for identifying energy-saving opportunities. Making customer data readily available is often viewed as one of the key customer benefits of advanced metering infrastructure investments. While utilities in the state are currently providing access to some electricity consumption data from smart meters, it is being provided in a variety of formats. Standardizing this data statewide to be consistent with a nationally recognized standard like Green Button "Download My Data" would allow for a more efficient analysis for EE and demand reduction opportunities by customers and any consultants or third parties they choose to work with. According to MissionData, a nonprofit dedicated to advocating for energy data access, over 55 utilities across the country have adopted the Green Button Download my Data standard.[167] Duke Energy has committed to start implementing a data access program equivalent to Green Button beginning in the third quarter of 2019. The NCUC has opened a docket to seek information and establish rules related to electric customer billing data, which is an opportunity for utilities, stakeholders and the Commission to have discussions about the desired functionality of a tool like Green Button.

In addition to the Download My Data standard, the Green Button initiative has established the Green Button "Connect My Data" program that allows customers to provide their chosen service providers with automatic access to their data. While Green Button "Connect My Data" has been proposed in NC, utilities have continued to express concerns related to customer protections, liability, regulatory cost recovery issues, and implementation cost. Utilities and interested stakeholders should continue to pursue ways to address those issues in addition to exploring other methods for providing automatic energy data transfers to trusted third parties such as Energy Star portfolio manager.

[167] Murray, Michael and Jim Hawley, "Got Data? The Value of Energy Data Access to Consumers," MissionData and More Than Smart, January 2016. Pg 8. https://static1.squarespace.com/static/52d5c817e4b062861277ea97/t/56b2ba9e356fb0b4c8sb7d/1454553838241/Got+Data+-+value+of+energy+data+access+to+consumers.pdf

Table K-2: Actions for Recommendation K-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
IOUs, municipal, and co-op utilities	Standardize existing data availability and provide easy access to 24 months of incremental usage data	Short term
NCUC	Ensure streamlined easy access to energy usage data for customers	Medium term
Legislature / NCUC	Review municipal and co-op utility implementation of Green Button Download My Data standard and determine if legislation is needed to ensure compliance	Medium term

K-3. Establish minimum EE goals within the existing REPS or establish an energy efficiency resource standard (EERS)

NC REPS allows energy efficiency measures to be used for meeting a portion of the purchase requirements. The ability to use EE measures varies by year and by utility type:

- Investor-owned utilities: 12.5% renewable energy (as % of retail sales) by 2021. EE measures can be used to meet up to 25% of this requirement, and up to 40% after 2021
- Electric cooperatives, municipal utilities: 10% renewable energy by 2018, and there is no limit on the amount that may be met through EE.

REPS defines "Energy efficiency measure" as an equipment, physical, or program change implemented after January 1, 2007, that results in less energy used to perform the same function. "Energy efficiency measure" includes energy produced from a combined heat and power system that uses nonrenewable energy resources; the term does not include demand-side management. Energy efficiency resource standards (EERS) refer to policies that require utilities and other covered entities to achieve quantitative goals for reducing energy use by a certain year. An EERS is similar in concept to a renewable enery portfolio standard. While the later requires that electric utilities generate a certain percentage of their electricity from renewable sources, in EERS requires that they achieve a certain amount of energy savings from energy efficiency measures.

The current REPS Program EE component is voluntary – it allows utilities to voluntarily meet part of their renewable energy targets through use of implemented EE Measures. This could be made more stringent by the creation of mandatory minimums for IOUs for their REPS target to be met with cost-effective EE measures beginning in 2021. A conservative target is preferred by utilities due to concern that EE opportunities that utilities can influence are declining as more mainstream efficient equipment becomes available to customers outside of utility EE programs. Requiring a minimum EE target ensures that EE remains a valued resource despite the gains in renewable energy and avoided cost comparisons that tend to make EE a less attractive component of the REPS program. Duke Energy Carolinas and Duke Energy Progress are currently meeting a 25% target and this recommendation would ensure their continued compliance. Dominion is not currently meeting a 25% minimum.

Table K-3: Actions for Recommendation K-3

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature	Modify existing REPS statute to require IOUs to meet mandatory minimum of their REPS obligations with EE measures or establish an energy efficiency resource standard (EERS) by 2021.	Short term

K-4. Enhance education and awareness around energy efficiency opportunities in K-12 schools and community colleges through an "Energy Efficiency Everywhere (E3)" project

Although every student in NC is directly impacted by our electricity generation and consumption, many students do not understand the basics of how our electricity is produced, the real environmental costs, and what actions can be taken at home and at school to reduce electricity consumption. Students and young adults are often well-versed in everyday technology but unaware of the technologies that produce the electricity that their devices depend upon. An understanding of NC's energy landscape and how consumers influence future decisions will help our students become more environmentally and scientifically literate and thus better prepare them for the careers and jobs of the future. The best way to bring this and similar topics into the classroom is to equip and train teachers through professional development workshops to ensure they are able and willing to teach our students these important topics.

The NC public school curricula for K-12 do not include an EE component. Nor do schools provide "career awareness" programming for students to learn about careers in EE. Teachers are left to learn about these issues on their own, should they want to bring EE into the classroom. Several NC institutions offer energy-focused trainings and certificate programs, including UNC Chapel Hill's Institute for the Environment and NC's Office of Environmental Education (training here earns state teachers Environmental Education Certification credit). DEQ and the U.S. Department of Energy (DOE) also offer a rich selection of energy-related materials and activities. In addition, broader science and technology curricula and training opportunities have been created in science-based centers[168] and community colleges.[169] However, these opportunities are too scattered and varied for most teachers to look through and evaluate on their own.

The primary goal of the Energy Efficiency Everywhere (E3) project is to support the implementation of EE curriculum programs within the existing educational systems of NC to include K-12 public school

[168] The NC Museum of Natural Sciences created the Educators of Excellence Institutes to support continued learning for educators: https://naturalsciences.org/learn/educators-of-excellence-institutes
[169] For example, Wake Technical Community College currently offers a Building Automation Certificate Program: https://www.waketech.edu/programs-courses/credit/credit-programs/air-conditioning-heating-refrigeration-technology/degrees-1

systems and county-based community colleges. Ideally, education programs would be developed and used within existing curriculums appropriate for each grade level. E3 would foster excitement about EE, educate students on the electricity consumption and generation in our state, encourage specific actions by individuals and communities to reduce energy usage, and raise public awareness to the benefits of pursuing EE skilled trade careers. The project would launch a professional development training program for teachers as well as other educators in NC, create a statewide EE certification certificate, and establish an online sharing platform for EE related activities and lessons for teachers to use in their classroom.

Table K-4: Actions for Recommendation K-4

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Academia or non-profit	Collaborate with the following entities to stand up a program to support implementation of EE curriculum programs within the existing educational systems in NC: • NC Community College Systems Office (NCCCSO) • NC Department of Public Instruction (DPI) • NC DEQ • NC Community Colleges • NC K-12 County School Systems • National Energy Education Development Project (NEED) • NC's EE industry organizations and corporate leaders • Accreditation organizations that oversee curriculum programs in K-12 & Community Colleges • School groups, science educators, state education public information officers, science-based centers and museums, superintendent offices and universities that are already involved in energy education, nonprofits that support this type of work and others. • Utility outreach and education programs	Medium term

K-5. Require utilities to develop innovative rate design pilots to encourage customer behavior that helps achieve clean energy goals, such as peak demand reduction, better utilization of renewable resources, and strategic storage deployment.[170]

Two trends underway in the electricity sector make better utilization of flexible loads essential: increasing amounts of low-cost, variable generation resources on the grid, and expanding technology options for customer control of energy use. By encouraging or enabling customers to use power at times when clean, cheap energy is available on the grid and avoid using it when the system is under stress, it is possible to reduce overall costs and increase the utilization of low cost renewable resources. Technologies such as programmable thermostats, water heaters, and electric vehicle chargers, and smart appliances that can automatically adjust usage by following a utility or aggregator signal, are giving customers and utilities new tools to easily manage customer energy usage to minimize system costs and save customers money on bills. Rate design, also known as the price that customers pay for electricity at various times of the day, season, and year, is an essential part of making this happen.

Utilities around the country are beginning to experiment with innovative rate structures and accompanying programs to reward customers for shifting their usage in a way that is beneficial to the grid. For example, in July 2019, Portland General Electric launched a Smart Grid Test Bed which will work with 20,000 customers to take advantage of demand-response signals and incentives for using smart-home technologies, helping customers control energy use and greenhouse gas emissions. In this pilot, the utility is automatically enrolling customers in a rate design that will reward them for shifting their energy use during times of grid stress. This approach of combining time-varying rates with technologies and programs that make it easy for customers to shift usage and utilize technologies like storage and smart devices, has proven effective elsewhere as well.[171]

In the general rate case in 2018, the NCUC directed Duke Energy Carolinas to implement innovative rate design pilots to allow customers to take advantage of peak and energy shifting opportunities from the roll-out of advanced meters. The conclusions of the Clean Energy Plan are supportive of the direction the Commission is taking in this instance.

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[170] Note: this recommendation is not from the EE Roadmap. It was prioritized by stakeholders in the Clean Energy Plan workshop and is included in this strategy area because of its direct link to demand-side management.
[171] Other utilities with successful programs along these lines include Baltimore Gas and Electric, Oklahoma Gas and Electric, Pacific Gas and Electric, and Hawaiian Electric Companies.

Table K-5: Actions for Recommendation K-5

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Require utilities to work with stakeholders to develop proposals for innovative, equitable rate design pilots that encourage customers to shift their usage and utilize technologies like storage to help reduce peak demand and increase utilization of clean energy. Pilot sites, co-located with low-income neighborhoods that have participated in the Duke Energy Neighborhood Energy Saver program, should be considered to further reduce energy burden rate for those residents	Short term
Co-ops and Municipal utilities	Work with stakeholders, customers, and member-owners to develop proposals for innovative, equitable rate design pilots that encourage customers to shift usage and utilize technologies like storage to help reduce peak demand and increase utilization of clean energy	Medium term

K-6. Increase EE awareness on the NC Building Code Council

The NC Building Code Council (NCBCC) was established to oversee the state's building codes, which include energy code. In addition, the state legislature may update building codes at any time. The Building Code Council is comprised of seventeen members, each representing a different area of expertise or constituent group as detailed in the state law.[172] Currently EE is not represented on the Building Code Council.

The NCBCC has regulatory control over the sources – buildings – of more than 50% of NC's energy consumption. This control is authorized by law and enacted by setting and managing the minimum energy code standards and voluntary measures for all new and existing residential, commercial and industrial buildings. For the past several years, the 17-member council, whose positions are established via the Legislature and appointed by the Governor, have supported weak increases in EE minimum code requirements and approved roll-backs of moderate, yet cost-effective, energy code increases. This action has led to NC's energy codes becoming less stringent when compared to other Southeastern states, national and international standards.

State-authorized energy codes play a major role in how a state acts on EE and, because NC is a Dillon Rule state, local jurisdictions are limited in how they can implement increased stringency (above state code) in local codes to support their own climate change and energy goals. To improve local and state support for EE, establishing greater support, understanding and action of the NCBCC is a fundamental starting point.

Responsible, cost-effective increases to minimum EE requirements in the NC building code would economically benefit the owners of residential and commercial building and reduce air pollution. Prudent, cost-effective energy code improvements could save up to $10 Billion (NCBPA, 2018) in direct avoided energy costs over the next ten years, offer significant environmental and health impacts to the state, and provide strong economic impacts through improved housing and property affordability, local economic development improvement and workforce development.

Florida is one of the few Southeastern states that has an EE, clean energy or green building seat on its code council. The Florida Building Commission includes a representative of the "green building industry" as well as from the Florida Office of Energy.

The EE Roadmap stakeholders identified the following actions as important to pursue: Improve the NC Building Code Council (NCBCC)'s support of EE by updating the energy conservation code to increase the EE requirements for buildings, modernizing the building code to ensure new buildings are ready for the installation of vehicle charging infrastructure and clean energy resources (e.g., rooftop solar and battery storage), and adding an Energy seat to the Council's makeup, and establishing new actionable goals that prioritize EE in NC's current and future building codes.

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[172] See the relevant NC Statutes here:
https://www.ncleg.gov/EnactedLegislation/Statutes/PDF/BySection/Chapter_143/GS_143-136.pdf

Table K-6: Actions for Recommendation K-6

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Legislature	Add Energy efficiency seat to the NCBCC	Short term
Building Code Council	Update the energy conservation code to increase the energy efficiency requirements for buildings	Short term
Building Code Council	Modernize the building code to ensure new buildings are ready for the installation of vehicle charging infrastructure and clean energy resources	Short term

L. Create strategies for electrification

Background and Rationale

Electrification is the conversion to electricity of end uses of energy that are currently fueled with fossil fuels. Beneficial electrification considers whether, in electrifying, consumers are able to save money on their total energy bills, environmental benefits are achieved, and benefits to the grid are maximized. Beneficial electrification is included in the same strategy area as EE because, despite resulting in a net increase in *electricity* use, measures that constitute beneficial electrification will result in a net decrease in total *energy* use (in British thermal units, or some other measure of total energy). Participants in the clean energy plan process identified beneficial electrification, particularly of the transportation sector, as a key opportunity for NC to meet its GHG emission reduction goals, provide North Carolinians with cleaner and cheaper transportation options, and give utilities the ability to manage new flexible loads for the benefit of the electric grid.

As the electricity sector has been becoming less carbon-intensive over the last decade, the transportation sector has become the second largest source of greenhouse gas emissions in the state. In 2017, the sector accounted for 32.5% and emitted 48.7 million metric tons of GHG emissions. Electrification of transportation presents a significant opportunity to reduce energy use and emissions from the sector due to the superior fuel efficiency of electrified transportation.[173] As the electricity sector becomes cleaner, electrification will result in greater emission reductions over time. In addition to reducing GHG emissions, electrifying transportation can result in reductions in local air pollutants such as particulate matter and NOx. This can make an especially big difference for communities that are most directly impacted by motor vehicle pollution, such as those in urban areas with diesel bus traffic or those located close to freeway corridors.

Electrifying transportation also presents new opportunities for communities and individuals to save money on fuel and operating costs of vehicles. Although the upfront cost of a new EV is still higher than comparable gasoline cars, this is changing quickly as battery technology continues to improve. This trend is occurring in the passenger vehicle market as well as for larger vehicles such as buses and fleet vehicles.

Under Executive Order 80, the state's Department of Transportation is developing a NC Zero Emission Vehicle (ZEV) Plan, designed to increase the number of registered ZEVs in the state to at least 80,000 by 2025 and plan for the charging infrastructure needed support this growth.[174] In April 2019, Duke Energy filed a plan with the NCUC for a $76 million investment in electric transportation infrastructure, including a statewide fast-charging station network. That plan is currently under review at the Commission. The recommendations described in this section are focused on how the utility sector can best integrate and encourage the adoption of electric vehicles and how the state can play a leadership role in accelerating transportation electrification.

[173] For example, the average electric vehicle has a fuel efficiency of roughly 30 kWh per 100 miles, which translates to a "miles-per-gallon equivalent" of about 112. This means that the average electric vehicle is 3-4 times more fuel efficient on an energy basis than a typical gasoline-powered vehicle. Note, this only considers the fuel efficiency of the vehicle itself, and not any energy used upstream of the vehicle.
[174] NC now allows retail resale of electricity for EV charging stations per House Bill 329 which signed into law by Governor Cooper on July 19, 2019.

Recommendations

L-1. Require utilities to develop innovative rate design pilots for electric vehicles to encourage off-peak charging of vehicles and to test effectiveness of different rate structures at shifting customer usage of the grid and encourage the adoption of electric vehicles.

Rate design, particularly when paired with smart chargers[175] or the programmable charging feature of an EV, can be very effective at encouraging drivers to charge their vehicles at times of the day when it is advantageous to the electric grid to do so. For example, a super-off-peak rate during the overnight hours will entice drivers to program their vehicles to wait to charge until that time period starts, avoiding the early evening hours that might otherwise exacerbate system peak demand. On a utility system that is solar-rich, such as the one in NC, it may be helpful for rate design to encourage workplace charging of EVs.

Not only can rate design help encourage the off-peak charging of vehicles, it can impact the economics of driving an EV as compared to a gasoline-powered vehicle. This is particularly true for charging stations located at commercial sites, such as workplaces, shopping centers, truck stops, etc. The typical rate design structure that utilities use for these kinds of customers can be a major inhibitor to the adoption and usage of charging infrastructure. Utilities are beginning to experiment with new structures that will recover costs from charging stations in a way that is more advantageous to the economics of EV charging.

State public utility commissions have begun to require utilities to employ the kinds of rate designs described above as a condition of approval for rate recovery of electric vehicle charging infrastructure.[176] In reviewing proposals from utilities regarding EV charging infrastructure, the NCUC could ensure that utilities plan to deploy rate designs that will encourage off peak charging and assist with EV adoption. As EV adoption increases in NC, innovative rate design programs can assist in broader clean transportation deployment as described in DOT's NC ZEV Plan.[177] The ZEV Plan outlines 4 key action areas that will support ZEV adoption: education, convenience, affordability, and policy.

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[175] The Washington State Utilities and Transportation Commission describes smart chargers as follows:

> Smart chargers provide enhanced capabilities that allow for data acquisition, network communication, and demand response, which will allow the Company to determine baseline charging profiles and to ultimately enable demand response programs.

See UTC, Docket UE-160799, Staff investigation regarding policy issues related to the implementation of RCW 80.28.360, electric vehicle supply equipment, Notice of Open Meeting, June 24, 2016. https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=4&year=2016&docketNumber=160799.

[176] Maryland, California, Nevada, and Michigan are some of the states that have recently issued orders requiring innovative EV rate designs.

[177] The NC ZEV Plan, another directive of EO 80, can be viewed at https://www.ncdot.gov/initiatives-policies/environmental/climate-change/Pages/electric-vehicles.aspx

Table L-1: Actions for Recommendation L-1

Entity Responsible	Action	Timing (Short, Medium, or Long term)
NCUC	Ensure that utility proposals for EV charging infrastructure deployment are accompanied by pilots designed to test innovative rate design that encourages off peak charging and EV adoption	Short term
Co-ops and Municipal Utilities	Implement EV rate designs that encourage off peak charging and EV adoption	Medium term

L-2. Conduct an analysis of the costs and benefits of using electrification to reduce energy burden and GHG emissions in end-use sectors in NC, such as in homes, buildings, transportation, industrial, and agricultural operations.

Clean Energy Plan stakeholders identified the electrification of transportation as a key strategy for reducing emissions from that sector, as more fully discussed in the final section. They also acknowledged that an economy-wide strategy to meet the state's GHG reduction goals would require emission reductions from other sectors in addition to electricity and transportation, such as fuel use in buildings, homes, industrial processes, and agricultural operations. Many studies have identified electrification of those energy end uses as potentially the most technologically feasible and least-cost strategy to reduce emissions from those sectors. Such a study has not been conducted for NC, and thus this clean energy plan process did not focus specifically on electrification as a GHG reduction strategy. However, given the importance of getting started on emission reductions from all sectors, stakeholders identified such a study as an important next step for the state.

Beneficial electrification has the potential to provide significant financial relief to 30% of NC residents living in poverty. Low income households spend a disproportionate percentage of their household income on energy costs relative to their higher income counterparts.[178] For those living with incomes below 50% of the Federal Poverty level, 33% of their annual income is spent on energy bills. Of this amount, about 20% is spent on electric bills while over 60% is spent on natural gas or bottled gas (see Supporting Document-Part 3 for more information). Examples of residential beneficial electrification include switching from electrical resistance space or water heating to using heat pump technologies for

[178] Fisher, Sheehan, & Colton (2019). Home Energy Affordability Gap. Accessed May 2019. www.homeenergyaffordabilitygap.com/.

heating. Heat pumps can provide 1.5 to 3 times more heat energy than the electrical energy they use, a big improvement from electrical resistance heating.[179]

The industrial sector also offers potential electrification benefits. Industries using thermal processes can shift to electrical process heating. Industrial induction heating offers more temperature precision, reduced start-up times and faster product throughput, and more flexible control strategy. These factors result in better quality products. In addition to process improvements, electrical induction heating can also improve site air quality and reduce noise levels in industrial operations.[180]

A NC study could identify beneficial electrification opportunities in different sectors, noting technologies offering the most benefits in terms of economics and environmental improvement.

Table L-2: Actions for Recommendation L-2

Entity Responsible	Action	Timing (Short, Medium, or Long term)
Academia	Initiate an analysis of the costs and benefits of electrification of end-use sectors such as homes, buildings, industrial processes, and agricultural operations	Medium term

[179] Farnsworth, Shipley, Lazar, & Colton (2018). Beneficial Electrification: Ensuring electrification in the public interest. Regulatory Assistance Project. Accessed at https://www.raponline.org/wp-content/uploads/2018/06/6-19-2018-RAP-BE-Principles2.pdf
[180] Deason, Wei, Leventis, Smith, & Schwartz (2018). Electrification of Buildings and Industry in the United States. Lawrence Berkeley National Laboratory. Accessed at http://eta-publications.lbl.gov/sites/default/files/electrification_of_buildings_and_industry_final_0.pdf

Next Steps

5. Conclusions and Next Steps

An ongoing transformation of North Carolina's electricity system requires ambitious actions at the state and local levels, with active participation from the private sector. To achieve the goals and performance measurement targets laid out in the CEP, a framework is needed that centers on strategic investments that provide long-term energy, economic, and environmental benefits. **Developing modern regulatory tools, market structures and processes to achieve state goals can set us on a path to lower risk, lower-cost and lower-impact energy future.**

In the coming months and years, the entities identified in this plan are called upon to lead this effort by carrying out the stated recommendations or make adjustments within their normal business and operational practices to achieve the collective vision. We recognize that certain strategies and actions will require additional deeper dives and detailed analysis when considering new legislation or amending existing policies/practices. Many experts from within the state and across the country are ready to work with North Carolina leaders to continue transforming our state into a national leader in clean energy economy.

nc.deq.gov/cleanenergyplan

North Carolina
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All North Carolina Clean Energy Plan documents and supporting documents can be found at:

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